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VOLUME 3 NUMBER 23

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-34849# Royal Aircraft Establishment, Farnborough (England).

LOW SPEED WIND TUNNEL TESTS ON THE FLOW IN BOMB BAYS AND ITS EFFECT ON DRAG AND VIBRATION

R. Fail, T. B. Owen, and R. C. W. Eyre May 1954 56 p refs (RAE-AERO-2511) CFSTI: HC $3.00/MF $0.50

(Declassified)

It is shown that two types of flow can exist in bomb bays. In shallow cells the main stream flows into the cell and impinges on the rear bulkhead giving high drag. In deep cells (height/length ratio greater than about 1/6) a vortex forms inside the cell and the main stream flows substantially outside. The drag is then low. In both cases bombs released inside the cell suffer large disturbances. Pressure fluctuations of large amplitude occur near the rear of the bomb bay with both types of flow. Thickening the boundary layer ahead of the bomb bay reduces the velocities inside the cell and therefore reduces the drag before the vortex forms and for both types of flow reduces bomb disturbances. A large proportion of the pressure fluctuations is associated with external bomb doors, the remainder is caused by the vertical rear bulkhead. When both of these features are eliminated the pressure fluctuations are reduced to a very low level. Tests on Canberra type bomb bays show that the flow is in a transitional state; the aerodynamic characteristics of the bomb bay are in close agreement with those of a simple rectangular bomb bay of the same height/length ratio. Author

N65-34905*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STATIC STABILITY CHARACTERISTICS OF SEVERAL RAKED-OFF CIRCULAR AND ELLIPTICAL CONES AT MACH 6.7

Peter T. Bernot Washington, NASA, Oct. 1965 23 p refs (NASA-TN-D-3053) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Longitudinal and lateral-directional aerodynamic characteristics of four circular cones and one elliptical cone were determined at a Mach number of 6.7 and were compared with Newtonian estimates. These models employed a range of rake-off angles from 68° to 51° that yielded estimated lift-drag ratios from 0.40 to 0.80 at 0° angle of attack. The measured values of normal- and axial-force coefficients exceeded predicted values by up to 13 percent over the test angle-of-attack range from 0° to 10°; the pitching-moment coefficients showed better agreement with theory. The circular-cone models yielded fair and good agreement with theory for the longitudinal and lateral-directional stability derivatives, respectively, whereas the elliptical-cone model showed excellent agreement. Also, good agreement between theory and experiment was obtained for the lift-drag ratios on the elliptical-cone model, but the data for the circular-cone models were 5 to 7.5 percent lower than the predicted values. The experimental data for the complete reentry vehicle confirm that the directional stability limit dictates center-of-gravity location for circular cones whereas the longitudinal stability limit is the deciding criterion for elliptical cones. Author

N65-34976# Royal Aircraft Establishment, Farnborough (England).

AERODYNAMIC COEFFICIENTS OF AEROFOIL SECTIONS AND WINGS, IN FREE MOLECULAR FLOW [DIE AERODYNAMISCHEN BEIWERTE VON PROFILEN UND TRAGFLUGELN IN DER FREIEN MOLEKULSTROMUNG]

J. W. Beck (Tech. Hochschule, München) Jun. 1965 44 p refs (RAE-LIB-TRANS-1115) CFSTI: HC $2.00/MF $0.50

This report is a continuation of earlier studies of aerofoils and bodies in free molecular flow. The aerodynamic coefficients of double-wedge aerofoils are evaluated, and compared with those of the flat plate. For comparison with later calculations at higher densities, the aerodynamic coefficients of lifting wings with flat plate profiles are then evaluated, for both yawed and symmetrical flow; and also when rolling about the longitudinal axis of the wing. Author

N65-34977# Royal Aircraft Establishment, Farnborough (England).

CONCERNING THE EQUIVALENCE BETWEEN HEAT-, FORCE- AND MASS-SOURCES [UBER DIE AQUIVALENZ VON WARME-, KRAFT-, UND MASSENQUELLEN]

D. Rues (DVL, Aachen) Jul. 1965 10 p refs Transl. into ENGLISH of a Rept. from Deut. Versuchsanstalt für Luft-und Raumfahrt, Aachen (W. Germany) (RAE-LIB-TRANS 1119) CFSTI: HC $1.00/MF $0.50

The author investigates the conditions under which mass, force, and energy sources can be interchanged without altering

certain parameters of a steady inviscid flow field. The parameters considered are the pressure potential, the velocity component in the direction of the undisturbed flow and the density. The effects of such sources on the drag of a two-dimensional aerofoil in subsonic flow are examined. Author

N65-34997*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF SPLITTER PLATES FOR SUPERSONIC TWIN INLETS
John B. Peterson, Jr. Washington, NASA [1965] 40 p refs Presented at the AGARD Specialist Meeting on Aerodyn. of Power Plant Installation, Tullahoma, Tenn., 25–27 Oct. 1965
(NASA-TM-X-56819) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An experimental investigation was conducted to determine the ability of various splitter plates to isolate twin inlets aerodynamically such that in the event that one inlet is unstarted, the operation of the other inlet will not be affected. The effects of pylon height, inlet mass flow, and inlet yaw, on the performance of splitter plates were investigated. A pylon mounted external-internal compression inlet model was used and the tests were made at a Mach number of 2.5 and a Reynolds number based on cowl diameter of 10.8×10^6 (approximately full-scale flight conditions for an aircraft such as a supersonic transport). It was determined that splitter plates of a practical size will isolate an unstarted inlet at least as long as the mass-flow ratio is maintained above approximately 0.65. Author

N65-35064*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF THICKNESS ON SUPERSONIC PERFORMANCE OF A WING-BODY CONFIGURATION EMPLOYING A WARPED HIGHLY SWEPT ARROW WING
F. Edward Mc Lean and Dennis E. Fuller Washington, NASA, Oct. 1965 29 p refs
(NASA-TN-D-3034) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An investigation was conducted to determine some of the effects of airfoil-section shape and thickness on the performance of a wing-body configuration which utilizes a warped wing with a relatively low design lift coefficient as compared with the optimum. Also, the design-lift-limited warped surface concept was explored. Five wing-body models were constructed and each had the same clipped arrow wing planform with 76° leading-edge sweep and an aspect ratio of 1.71. The body of each model had the same longitudinal area distribution and was scaled to satisfy the volume and space requirements of a supersonic transport. The warped mean wing surface of three models was designed for a Mach number of 2.6 and the design lift coefficient (0.063) was purposely limited to a value well below the theoretical optimum lift coefficient of 0.148. The five models were tested in a wind tunnel at Mach numbers of 2.4, 2.6, and 2.86 and a Reynolds number of 3.5×10^6. Lift, drag, and longitudinal stability characteristics are presented along with some comparisons with theory. C.T.C.

N65-35065*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC CHARACTERISTICS IN PITCH OF SEVERAL M-WING-BODY COMBINATIONS AT MACH NUMBERS OF 2.40, 2.60, AND 2.86
Odell A. Morris and F. Edward Mc Lean Washington, NASA, Oct. 1965 34 p refs
(NASA-TN-D-3035) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An investigation has been made in the Langley unitary plan wind tunnel at Mach numbers of 2.40, 2.60, and 2.86 to determine the longitudinal aerodynamic characteristics of several M-wing–body configurations. The results have been compared with those from tests of a similar wing–body combination having an arrow-wing planform. The M-wing planform provided a considerable improvement in pitching-moment linearity over that obtained with the arrow-wing planform for both the flat and the warped wings. The flat M-wing model indicated maximum values of lift-drag ratio that were slightly higher than those obtained for the flat arrow-wing model at a Mach number of 2.40 but somewhat lower at Mach numbers of 2.60 and 2.86. The warped M-wing model generally showed only slightly higher maximum values of lift-drag ratio than the flat M-wing model but did provide positive values of pitching moment at zero lift which would improve the longitudinal trim characteristics. The warped M-wing model had lower maximum values of lift-drag ratio than the warped arrow-wing model at each test Mach number due to a higher minimum drag level and a higher drag due to lift. Author

N65-35175# Aeronautical Research Council (Gt. Brit.)
EXPERIMENTS AT HYPERSONIC SPEEDS ON CIRCULAR CONES AT INCIDENCE
D. H. Peckham London, HMSO, Jan. 1963 30 p refs Supersedes RAE-TN-AERO-2863, ARC-24946
(ARC-CP-702; RAE-TN-AERO-2863; ARC-24946) CFSTI: HC $2.00/MF $0.50

Pressure distribution measurements on five circular cones with total apex-angles ranging from 25 to 45 degrees are described. The tests covered a range of angles of incidence from 0 to 30 degrees, at Mach numbers of 6.85 and 8.60. The extent to which various analytical and empirical theories predict the measured pressures is assessed. Author

N65-35192# Lockheed-California Co., Burbank.
EFFECT OF MACH NUMBER, REYNOLDS NUMBER, AND THICKNESS RATIO ON THE AERODYNAMIC CHARACTERISTICS OF NACA 63A-SERIES OF AIRFOIL SECTIONS
O. E. Sipe, Jr. and N. B. Gokenberg Fort Eustis, Va., U. S. Army Aviation Mater. Labs., Jun. 1965 461 p refs
(Contract DA-44-177-AMC-144(T))
(LR-18596, USAAML-TR-65-28, AD-619153)

Force and moment data are presented from wind tunnel tests of two-dimensional symmetrical NACA 63A-Series airfoils of thickness ratios from 9 to 18 percent. The tests were conducted at Mach numbers ranging from M = .94, with Reynolds numbers varying from $R = 2.0 \times 10^6$ to $R = 9.5 \times 10^6$ and at angles of attack as high as 29 degrees. Comparisons are made, wherever possible, with NACA tests of the same or similar airfoils. The transonic similarity rule is used to evaluate the consistency of the data. Author

N65-35210*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SELF-INDUCED BALLOON MOTIONS AND THEIR EFFECTS ON WIND DATA
Harold N. Murrow and Robert M. Henry [1964] 23 p refs Presented at the AMS 5th Conf. on Appl. Meteorology; Atmospheric Probl. of Aerospace Vehicles, Atlantic City, 2–6 Mar. 1964
(NASA-TM-X-54625) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Examples of self-induced motions of spherical balloons ascending in still air inside a large hanger are shown and discussed. Analogies with self-induced motions of other types of spheres such as bullets and balls are considered. The effect of these self-induced motions on wind measurements derived from balloon tracking is described. Finally, some approaches to the reduction or elimination of the self-induced motions are indicated, and results of some preliminary tests of modified balloons are discussed. Author

N65-35225*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

AERODYNAMIC TESTING USING SPECIAL AIRCRAFT

Hubert M. Drake [1964] 36 p refs Presented at the AIAA Aerodyn. Testing Conf., Washington, 9–10 Mar. 1964

(NASA-TM-X-51605) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The reasons for full-scale flight research with special aircraft are presented in a paper presented at a conference on aerodynamic testing. Special types of aircraft are discussed and the use of special operational procedures, such as air-launching, are considered. The application of special aircraft to configuration testing is detailed, and costs of specific projects are tabulated. Special aircraft for flight simulation in the areas of (1) performance and operation and (2) handling qualities are discussed; and a procedure for utilizing special aircraft is presented. M.W.R.

N65-35232*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A SUMMARY OF HINGELESS-ROTOR RESEARCH AT NASA—LANGLEY

John F. Ward and Robert J. Huston [1964] 28 p refs Presented at the 20th Ann. Natl. Forum of the Am. Helicopter Soc., Washington, 13–15 May 1964

(NASA-TM-X-51513) CFSTI: HC $2.00/MF $0.50 CSCL 01A

This paper summarizes hingeless rotor research investigations. These investigations include first an exploratory flight test program utilizing a three-blade hingeless rotor installed on a H-13 helicopter; and, second, the wind tunnel testing of an aeroelastically scaled research model of a hingeless rotor helicopter at simulated forward speeds up to 270 mph with full-scale Reynolds number and Mach number simulation. The third area of effort deals with the analytical treatment of the hingeless rotor. This work was done to define the fundamental reasons behind the results obtained in the experimental investigations. The flight test program results illustrate the improved control power and damping characteristics of the hingeless rotor system and the influence of the increased maneuverability on the rotor structural loads. The results of the dynamic model wind tunnel investigation include a summary of the effect on structural loads and dynamics of reducing rotor blade chordwise stiffness to the level of the blade flapwise stiffness. Author

N65-35260*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FM TELEMETRY AND FREE-FLIGHT TECHNIQUES FOR AERODYNAMIC MEASUREMENTS IN CONVENTIONAL WIND TUNNELS

Ronald J. Hruby and John B. Mc Devitt [1964] 25 p refs Presented at the 21st Semiannual Meeting of the Supersonic Tunnel Assoc., Princeton, 6–7 Apr. 1964

(NASA-TM-X-51648) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A description of the FM telemetry system is presented followed by a discussion of the free flight technique. Base pressure measurements for a 15° half-angle cone in free flight at hypersonic speeds were also presented to illustrate the practical application of these methods in aerodynamic testing. The FM telemetry system is used to measure base pressures in free flight on conical tests models and afterbody pressures on entry vehicles such as the Apollo configuration. The response time of the pressure sensing system was found to be less than 1 millisecond in most applications. In addition, possible temperature interaction effects were effectively eliminated by use of a temperature compensating circuit in the telemeter and by mounting the telemeter in plastic test models so as to thermally insulate the electronic components from the surrounding hypersonic flow field during wind tunnel testing. R.W.H.

N65-35330# Aeronautical Research Council (Gt. Brit.)

MEASUREMENTS OF ZERO-LIFT DRAG AT SUPERSONIC SPEEDS FOR A SYMMETRICAL SLENDER WING MODEL WITH DIFFERENT ROUGHNESS BANDS

E. C. Carter 1964 31 p refs Supersedes ARA-WTN-48; ARC-24838; See N63-17578

(ARC-CP-741; ARA-WTN-48; ARC-24838) CFSTI: HC $2.00/MF $0.50

This paper gives the results of tests in the supersonic tunnel on a slender ogee wing to determine the drag at zero lift for the model fitted with various alternative roughness bands. Tests were made at Mach numbers from $M = 1.6$ to $M = 2.4$ over a wide range of Reynolds number from about $R = 2.5 \times 10^6$ to $R = 7 \times 10^6$, based on the wing root chord of 2 ft. Author

N65-35387# Weapons Research Establishment (Australia).

A SECOND ORDER SUPERSONIC THEORY FOR THREE-DIMENSIONAL WINGS.

D. H. Lee and L. M. Sheppard Jul. 1965 18 p refs

(WRE-TN-HSA-108) CFSTI: HC $1.00/MF $0.50

A description is given of a general second order supersonic wing theory, which is based upon an approximate particular integral for the second order velocity potential. Comparisons are made with an exact theory, a complete second order theory and a modified first order theory. For the special case of a supersonic-edged delta wing the approximate second order theory is shown to be surprisingly effective. Author

N65-35404*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LATERAL DIRECTIONAL STABILITY CHARACTERISTICS AT MACH 2.3 TO 3.5 OF A SUPERSONIC TRANSPORT MODEL WITH VARIOUS OUTBOARD VERTICAL-TAIL LOCATIONS

William A. Corlett Washington, NASA, Oct. 1965 32 p refs

(NASA-TM-X-1151) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An investigation of a configuration with a highly swept blended wing-body and outboard tail surfaces has been conducted at Mach numbers from 2.3 to 3.5 to determine the effect of vertical-tail area above and below the wing-chord plane on the lateral directional stability characteristics of a transport model. The results indicated that at low to moderate angles of attack the model with all the vertical-tail area above the wing-chord plane generally provided the highest directional-stability level, although at high supersonic Mach numbers, particularly at high angles of attack, the vertical tail surfaces below the wing-chord plane tended to become more favorable. Wing-mounted nacelles, however, detracted from the effectiveness of the lower tail surfaces Canting the tail surfaces of the amount used for these tests had an effect on the directional stability only when applied to the lower tail surfaces. For this condition, toe-out led to increases in directional stability whereas toe-in led to decreases in directional stability. Locating the vertical tail surfaces below the wing-chord plane produced only a small reduction in effective dihedral; but, because of the accompanying decrease in the directional-stability parameter, the ratio of the directional-stability parameter to the effective-dihedral parameter was greater for the configuration with the vertical tail surfaces in the upermost position. Author

N65-35447# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
UNSTEADY AERODYNAMICS FOR ADVANCED CONFIGURATIONS. PART V: UNSTEADY POTENTIAL FLOW AROUND SLENDER BODIES AT ANGLES OF ATTACK Technical Documentary Report, 1 Apr., 1963–Sep. 1964
T. C. Li Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1965 49 p refs
(Contract AF 33(657)-10399)
(SID-64-1512-5; FDL-TDR-64-152, Pt. V; AD-619397)

Linearized theory is developed for potential flow around a slender body at not too large angles of attack. The solution is obtained by definitizing the flow equation and rigorously satisfying the boundary conditions. This approach is completely different from conventional methods in that it constitutes a process of obtaining an analytic solution to the problem of potential flow by a march from the body towards infinity. The extension of this new theory to the nonlinear case is immediate. Since there is no restriction of the Mach number, it is expected that the new theory should be applicable to the cases of subsonic, transonic and supersonic speeds as well. Author

N65-35457# Aeronautical Research Council (Gt. Brit.)
MEASUREMENTS AT SUBSONIC AND SUPERSONIC SPEEDS OF THE LONGITUDINAL AND LATERAL STABILITY OF A SLENDER CAMBERED OGEE WING INCLUDING THE EFFECTS OF A FIN, CANOPY NOSE AND TRAILING-EDGE CONTROLS
D. Isaacs London, HMSO, 1965 61 p refs Supersedes RAE-AERO-2679; ARC-25598
(ARC-RM-3390; RAE-AERO-2679; ARC-25598) CFSTI: HC $3.00/MF $0.75

The results show that for longitudinal stability at $M = 0.3$ and $C_L = 0.45$, the centre of gravity of an actual aircraft could be located only forward of 45% $\bar{c}$ (66% c_o). The centre of pressure of the wing with basic nose and no fin is at 53% $\bar{c}$ (71% c_o) at the cruise attitude, $M = 2.2$ and $C_L = 0.075$, so that the camber used is insufficient to trim the wing. Measured values of the drag increments due to control deflection show fair agreement with linear-theory estimates. The control effectiveness can be predicted with fair accuracy. The canopy nose is slightly de-stabilizing in yaw, and it has a drag penalty which is probably larger than could be tolerated (30% of basic wing wave drag). At supersonic speeds slender-body theory is generally inadequate for predicting the lateral derivatives of the wing. The fin effectiveness can be estimated with good accuracy. Author

N65-35516# Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL MEASUREMENTS AT MACH NUMBERS UP TO 2.80 OF THE EFFECTS OF GULLING ON THE LONGITUDINAL AND LATERAL STABILITY AND DRAG OF A CAMBERED, SLENDER OGEE WING
T. A. Cook London, HMSO, 1965 20 p refs Supersedes RAE-TN-AERO-2974; ARC-26700
(ARC-CP-803; RAE-TN-AERO-2974; ARC-26700) CFSTI: HC $1.00/MF $0.50

Tests have been made at M = 0.31, 1.40, 1.80, 2.20, 2.40 and 2.80 on a cambered, slender ogee wing with spanwise camber designed to reduce the size of rolling moment due to sideslip at low speed. The results are compared with those for a similar model without spanwise camber and show that, at M = 0.31, gulling has resulted in loss of $-l_v$ as required, together with reductions in y_v and n_v and an increase in nonlinear lift, probably at the drooped tips. Similar effects are obtained at supersonic speeds, though the effect of gulling on $-l_v$ diminishes with increasing Mach number. At supersonic speeds, there is a small increase of drag at zero lift, which appears to be explained by the increase of surface area of the gulled wing. Author

N65-35523*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A 1/6-SCALE MODEL OF THE FINAL TWO STAGES OF THE ARGO D-4 FOUR-STAGE ROCKET VEHICLE
Clyde Hayes and William A. Corlett Washington, NASA, Oct. 1965 21 p
(NASA-TM-X-1152) CFSTI: HC $1.00/MF $0.50 CSCL 01A

An investigation has been made to determine the aerodynamic characteristics of a 1/6-scale model of the final two stages of the Argo D-4 rocket vehicle. Three sets of cruciform fins were investigated on the model. Two sets were trapezoidal in planform, had a flat double-wedge airfoil section, and differed only in size. The third set had an area equal to that of the larger trapezoidal fins, but had swept leading and trailing edges and a single-wedge airfoil section. All the fin configurations were tested with the fins canted 1.1° to provide positive roll. In addition, the small trapezoidal fins were tested with the fins uncanted and also in a 45° roll attitude. The investigation was conducted at Mach numbers from 2.30 to 4.63 at a Reynolds number per foot (per 0.3048 m) of 3.0×10^6. The results of the investigation indicated that the swept-fin configuration provided greater longitudinal stability than the trapezoidal-fin configuration of equal area because of a greater effective moment arm and a generally increased lift-curve slope. The swept-fin configuration also provided a greater rolling moment than the trapezoidal-fin configuration of equal area. Author

N65-35536# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW SYSTEM OF MODULATED RADIO RECEPTION OF WEAK SIGNALS AND ITS APPLICATION FOR THE CREATION OF A RADIO TELESCOPE OF ULTRAHIGH RESOLVING POWER
V. V. Vitkevich 4 Aug. 1965 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (USSR), v. 102, no. 3, 1953 p 469–472 Presented at the Colloq. of the Oscillation Lab. of the Phys. Inst. of the Acad. of Sci., USSR, 22 Apr. 1954
(FTD-TT-65-570/1+2+4; AD-619328)

A new radio reception system for modulating weak signals is described and its application in developing a new ultrahigh resolving power radio telescope is discussed. R.N.A.

N65-35612# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
HYPERSONIC FLOW FIELD ABOUT A BLUNT NOSED CONE AT ANGLE OF ATTACK, PHASE II
Robert J. Polutchko and Bror O. Hultgren Wright-Patterson AFB, Ohio, ARL, Dec. 1964 62 p refs
(Contract AF 33(616)-7818)
(ARL-64-214; AD-615904)

This report describes Phase II of an experimental research program to investigate the flow fields about blunt nosed wings and bodies at angle of attack. Phase II is an investigation of the inviscid three-dimensional flow field about a truncated 10° half-angle cone at Mach numbers of 4.07 and 7.6 and angles of attack up to 20° By traversing the flow between the body and the bow shock with a conical probe at various cross-flow planes the thermodynamic state variable and Mach number profiles are established for each angle of attack. Schlieren photographs of vertical meridian shock wave shapes were taken. Estimates of the three-dimensional shock locus are included. Author

N65-35635# Naval Ordnance Lab., White Oak, Md.
AN IBM 7090 SIX-DEGREE-OF FREEDOM TRAJECTORY PROGRAM Aerodynamics Research Report No. 237
William E. De Grafft May 1965 66 p refs
(NOLTR-64-225; AD-614699)

This report presents a six-degree-of-freedom trajectory program which describes the unpowered flight of a rigid body in the vicinity of a spherical rotating earth. The program is written for an IBM 7090 computer operating under the IBSYS monitor. The mathematical formulation of the problem and the computer program itself are presented. The program description includes a FORTRAN listing and instructions for its use. Author

N65-35671# Kaman Aircraft Corp., Colorado Springs, Colo. Kaman Nuclear Div.
FEASIBILITY OF A MATHEMATICAL/STATISTICAL TECHNIQUE TO ESTIMATE MAXIMUM AEROSPACE VEHICLE RESPONSE TO WIND Final Report, 1 Jul. 1964–31 Mar. 1965
C. Eugene Buell 31 Mar. 1965 73 p refs
(Contract AF 19(628)-4299)
(KN-65-699(FR); AD-617352)

The feasibility of a mathematical/statistical technique for determining the distribution of maximum aerospace vehicle structural and control response from the more advanced presentations of upper-wind climatology (means, standard deviations, and inter-level correlation matrices of orthogonal wind components at equally spaced levels) is investigated. It is concluded that the development of such a technique is feasible but not without some problem areas. The steps of development of such a technique appear to be as follows: First, the development of a reasonable linear system of differential equations that is equivalent (in a special sense) to the dynamical equations of motion and response of the vehicle. Second, the establishment of the relation of response statistics of the vehicle to the wind statistics by means of the preceding differential equations. Third, from the statistics of vehicle response, to determine the statistics of the maximum vehicle response. Some preliminary results in several of the important areas are outlined. Author

N65-35698# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL STUDY OF A MODEL CONTROL BLEEDER STAGE WITH A ROTATING DIAPHRAGM
M. Ye. Deych and A. G. Sheynkman 2 Jul. 1965 15 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 2, 1965 p 14–17
(FTD-TT-65-669/1+2+4; AD-617679)

The efficiency, η, of a steam turbine model control bleeder stage with a rotating diaphragm is compared to a stage with a throttle valve. Formulas for the determination of response are presented. It was established that under experimental conditions with partial discharge, the control stage with rotating diaphragm has an efficiency greater by $\Delta\eta = 0.05$ to 0.10 than the stage with a throttle valve. Calculations for stage efficiency and for the coefficient of diaphragm discharge based on static test conditions are in good agreement with results of tests in the steam turbine. L.S.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-34806 Raven Industries, Inc., Sioux Falls, S. Dak.
IMPROVEMENT IN BALLOON DESIGN THROUGH SCALE MODEL ANALYSIS
J. A. Winker *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 27–39 (See N65-34804 23-20)

The history of plastic ballooning has been one of ever-increasing demand for payload and altitude capability. To meet this challenge, improvements must be made either in balloon materials or in design. In recent years much effort has been applied to the materials aspect of the problem with gratifying but expensive results. New design concepts are called for which will extend the capability of less expensive balloons. Since most balloon failures occur at midaltitudes on ascent, more must be learned about the stresses on partially inflated balloons. A scale model study has been instituted to investigate the configurations and stresses for this condition. Initial work has been aimed at establishing model laws and at comparing different standard balloon designs. A new balloon design has been explored by this technique and preliminary verification of the model data has been made in full-scale flights. Author

N65-34812 Air Force Cambridge Research Labs., Bedford, Mass.
BALLOON BURST DISCUSSION
N. Sissenwine *In its* Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 85–93 (See N65-34804 23-20)

Wind data on shear and turbulence forces in the tropopause are presented to determine their influence in the tearing and bursting of large balloons. Although no definite conclusions were drawn, the data indicate that shear forces are not sufficient to cause balloon burst, while small-scale turbulences or gusts can exert strong tearing forces on the balloons. R.N.A.

N65-34813 Anderson, Greenwood and Co., Houston, Tex.
BALLOON LAUNCHING FROM AIRPLANES AND HELICOPTERS
Lomis Slaughter *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 95–114 (See N65-34804 23-20)

The purpose of this report is to advise balloon users and potential balloon users that, through work sponsored by AFCRL, techniques have been developed for launching balloons and balloon-supported payloads from high speed airplanes. Additionally, a sound start has been made on a technology for the launching of balloons from helicopters. To make these minimum statements more meaningful, this report sketches the state-of-the-art in these two areas discussing the techniques, the current experience level as to payload weights, balloon sizes, and aircraft speeds, and touches on the basic economics of pounds and dollars. Author

N65-34814 Sea-Space Systems, Inc., Torrance, Calif.
ULTRA THIN FILM BALLOONS
Dale W. Cox, Jr. *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 115–119 (See N65-34804 23-20)

Good quality ultra thin film material with a gauge of 1/10 mil was developed using special experimental resins for balloon application. Float altitudes in excess of 150,000 ft have been achieved with balloons made of this material carrying a payload of 25 lbs. The 1.25×10^6 ft^3 balloons have a natural shape design, a gore length of 200 ft, a maximum diameter of 138 ft, and weigh 91 lbs. The material showed no failure or damage in cold brittleness tests conducted on a twist-flex machine in liquid nitrogen. On one flight a balloon successfully ascended through a −97° F tropopause with a wind shear of approximately 56 knots in 7000 ft of altitude. Work is in progress on developing a 3.5×10^6 ft^3 balloon capable of lofting a 100 lb payload to 150,000 ft or a 35 lb payload to 154,000 ft, and a 4.5×10^6 ft^3 balloon for lofting a 25 lb payload to 158,000 ft. R.N.A.

N65-34820 Kaysam Corp. of America, Paterson, N. J.
TWO NEW SPECIAL PURPOSE METEOROLOGICAL BALLOONS
Eric Nelson and Moses Sharenow (Army Electron. Res. and Develop. Lab.) *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 187–203 refs (See N65-34804 23-20)

The development of meteorological balloons capable of passing through temperature zones as low as −85° C and reaching altitudes of 100 000 feet is presented. Thirty-one balloon flights were performed to demonstrate the validity of a film which was evaluated for its elongation and brittleness characteristics at low temperatures. The balloons were tracted to burst; the first 3 flights were made in the daytime and the remaining 28 were conducted during the hours of darkness. Twenty-seven, or 87%, reached altitudes in excess of 100 000 feet; 83 1/2% of the tropical flights exceeded the 100 000-foot level as did 85% of the arctic flights. Design and flight performance of a balloon vehicle capable of reaching altitudes of 100 000 feet at a very rapid rate of ascent, 1700 feet per minute during the daytime and 1600 feet per minute at night, is also discussed. The vehicle is fabricated from a combination of two balloons; a high-altitude balloon enclosed in a streamlined balloon. Theoretical concepts including the equation of motion for meteorological balloons are reviewed. M.R.W.

N65-34821 National Center for Atmospheric Research, Boulder, Colo.
SUPERPRESSURE BALLOON FLIGHTS FROM JAPAN
Vincent E. Lally *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 205–211 (See N65-34804 23-20)

The flight of superpressure balloons from Japan is discussed. A table summarizing the flights is included and the trajectories of some of the longer flights are presented graphically. A balloon navigating and tracking system was evaluated, and a brief description of its design and operation is presented. M.R.W.

N65-34822 Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
INSTABILITY OF SPHERICAL WIND-SENSING BALLOONS
Daniel F. Reid *In its* Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 213–227 refs (See N65-34804 23-20)

A description of the "ROSE" wind-sensing technique is presented. The problem of balloon instability as discovered during experiments at the Lakehurst Naval Air Station in the large airship dock is described with examples of balloon trajectories. Water analogy experiments being conducted at University of Southern California, Los Angeles (U.C.L.A.) and their relationship to the balloon instability are discussed. A theory relating the instability to the balloon's wake is presented with possible solutions. Recent experimentation at Eglin Air Force Base, Florida, is described and the preliminary results presented. The optimum "quick fix" to the standard balloon and the recommended new design are presented. Author

N65-34828 Air Force Cambridge Research Labs., Bedford, Mass.
QUALITY ENGINEERING OF SCRIM-REINFORCED BALLOONS
T. W. Kelly, A. O. Korn, L. Curtis, and R. Moroney (Schjeldahl (G. T.) Co., Northfield, Minn.) *In its* Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 317–335 (See N65-34804 23-20)

The scrim-reinforced Mylar balloon is a highly reliable carrier for heavy, expensive, scientific payloads but has been prohibitively expensive for general use. A 30 percent cost reduction has resulted from an 18-month program evaluating new films, fibers, and adhesives, refined lamination techniques, and balloon design simplification in combination with streamlined production procedures. The successful flight test of a nonwoven scrim balloon, the development of a novel nonwoven scrim loom, as well as scheduled tests for balloon recovery and reuse, promise to further reduce the cost differential between supported and unsupported film balloons. Author

N65-34830 RAND Corp., Santa Monica, Calif.
THE MARS BALLOON—FEASIBILITY AND DESIGN
M. H. Davis and S. M. Greenfield *In* AFCRL Pocr., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 341–351 refs (See N65-34804 23-20)

The feasibility of Mars balloon operations are discussed. Estimates of the weight and volume requirements for such a balloon system are given. Two balloon types are considered: (1) A balloon to carry instruments from one point on the planet surface to another point nearby for which hydrogen-filled balloons of the equal-pressure type are visualized. (2) A balloon to float at a fairly high altitude for long periods carrying instruments designed to observe the atmosphere and surface for which a ballasted equal-pressure balloon or the superpressure balloon is considered. Air-launched systems are suggested for the Mars balloon. Equations are given for the ratio of balloon mass to total system mass, and the ratio of payload volume to total system volume. Also, parameters of the system are tabulated. No calculations made indicate that the Mars balloon concept is invalid. E.E.B.

N65-34831 RAND Corp., Santa Monica, Calif.
BALLOONS FOR THE SCIENTIFIC EXPLORATION OF MARS
S. M. Greenfield and M. H. Davis *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 353–363 refs (See N65-34804 23-20)

A discussion of how balloons can contribute to the exploration of a planet like Mars, and how their derived capability translates into a scientific utility, is presented. In considering the usefulness of balloons for the scientific exploration of a planet, the following modes of operation are focused on: (1) the balloon used as a sensor, (2) the balloon used as a platform, and (3) the balloon used as a conveyance. Proposed are possible experiments for the exploration of Mars. The question of how such a set of experiments meshes with derived balloon capabilities is also examined. S.C.W.

N65-34832 Winzen Research, Inc., Minneapolis, Minn.
THE BALLOON AS A STEPPING-STONE TO SPACE FLIGHT
Otto C. Winzen *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 365–391 (See N65-34804 23-20)

The plastic balloon vehicle, native to the United States, is a valuable, proven test platform which could serve to fill the gap between earth-bound simulators and final space flight. Balloons operate at an altitude where the environment, both physically and psychologically, resembles closely that of space flight. The balloon vehicle is uniquely capable as a manned space station analog with the capability of long flight duration, at low cost and immediate availability. In the search to reduce the exorbitant cost of test programs leading to manned and unmanned space flight, we would be remiss not to explore its unique capabilities. The high confidence level achieved by seven successful major manned flights made by Winzen Research Inc. for the U.S. Navy and U.S. Air Force add to the attractiveness of the vehicle. The paper presents illustrations of these operations, illustrations of polyethylene balloon capabilities, and advanced concepts. Author

N65-34834 Observatoire de Paris (France). Section d'Astrophysique.
THE TECHNIQUE OF CLUSTERS OF SOUNDING BALLOONS
Audouin Dollfus *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 399–407 ref (See N65-34804 23-20)

A method for linking dilatable sounding balloons for the purpose of carrying heavy payloads was developed. Each balloon has two necks, one at the bottom and the other diametrically opposite at the top. A vertical cable is passed through the two necks; the inferior neck is linked to the cable and carries the lift; the zenithal neck is gas-tight around the cable, but can slip along this cable to accommodate the balloon's increase in size with altitude. By ropes and winches it was possible to build up more than 30 such balloons. Using these balloon clusters, flights with instrumental payloads were conducted to study wind shear structures, scintillation of stars, and disturbances in telescopic observations. These investigations are summarized. M.R.W.

N65-34836 Honeywell, Inc., Hopkins, Minn.
THE PARAVULCOON RECOVERY SYSTEM: AERIAL DEPLOYMENT FEASIBILITY STUDIES
A. J. Oberg, R. A. Pohl, and C. L. Pritchard *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 419–441 (See N65-34804 23-20)

The Paravulcoon System is a terminal recovery scheme wherein the buoyancy of an aerially-deployed, inflated, and heated balloon filled with hot air is used to accomplish the atmospheric flotation and controlled descent to touchdown of the recovered body. The aerial-deployment phases of the system-activation sequence have not been previously demonstrated with practical sized systems, and furthermore are not amenable to analytical verification. Therefore, the program reported here was undertaken to experimentally demonstrate their feasibility. In this paper a brief description of the system concept and components is presented, and the experimental program objectives are defined. Then, the actual wind tunnel and free flight experimental studies are described and discussed. Author

N65-34978# College of Aeronautics, Cranfield (England).
AEROPLANE DESIGN STUDIES MACH 2.2 AND MACH 3.0 SUPERSONIC AIRLINERS (ACADEMIC YEARS 1960 AND 1962)
D. Howe Feb. 1965 74 p refs
(CoA-AREO-181) CFSTI: HC $3.00/MF $0.75

The designs of the A-60 Mach 2.2 airliner and the A-62 Mach 3.0 airliner are described and compared. The Mach 2.2 design was based on the use of a slender delta layout with six turbojet engines buried in the rear fuselage, and was intended to carry up to 120 passengers. Although the chosen engine installation enabled a compact aircraft to be designed, it introduced severe structural and installation difficulties. A canard delta arrangement was proposed for the Mach 3.0 aircraft. Drooping of the wing tips for supersonic flight conferred important stability advantages without introducing an unacceptable weight penalty. The steel structure was designed using both corrugated reinforced and honeycomb sandwich skins, the former being preferable. A sealed cryogenic environmental control system was found to be attractive but proved to be heavier than expected. A good compromise could be obtained using a more conventional system. The Mach 2.2 aircraft represents a more logical step from existing airliner designs and presents fewer materials problems. Economically, it represents a better choice for a first generation supersonic design. R.N.A.

N65-34999*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
APPLICATION OF THE MODEL TECHNIQUE TO A VARIABLE-STABILITY HELICOPTER FOR SIMULATION OF VTOL HANDLING QUALITIES
John F. Garren, Jr. and James R. Kelly Washington, NASA [1965] 22 p refs Presented at the 27th Meeting of the AGARD Flight Mech. Panel, Rome, 11–12 Oct. 1965
(NASA-TM-X-56821) CFSTI: HC $1.00/MF $0.50 CSCL 01C

In order to provide a means for accurate in-flight simulation of V/STOL aircraft, a computer model technique has been adapted to a variable-stability helicopter. Unlike the stability-derivative simulation technique, which is usually employed in variable-stability aircraft, the model approach produces a response which is essentially independent of the dynamics of the test vehicle. The aircraft response, therefore, is a function only of the evaluation pilot's control inputs and the dynamics which are programed into the analog computing equipment. In-flight time histories of the helicopter response and the corresponding commanded response are presented to illustrate the effectiveness of the technique. The results indicate that the model technique does, in fact, provide a feasible, accurate, and flexible approach to in-flight simulation. Author

N65-35000# Royal Swedish Academy of Engineering Sciences, Stockholm.
COMPUTATION OF EQUAL-NOISE CONTOURS FOR AIRCRAFTS
Stig Ingemansson and Jan Soderquist 1965 40 p refs *Its* ACTA Polytech. Scand. Phys. including Nucleonics Ser. No. 34 (Ph-34) CFSTI: HC $2.00/MF $0.50

Calculation of the extent and intensity of noise in the vicinity of an airport is considered in terms of an equation to compute the noise generated by a starting aircraft and climb path data. Sound levels can be found for distances up to 10000 meters from the flight path of both turbojet and propeller aircrafts; and widths of equal-noise contours can be shown for areas which exceed certain noise levels. Propagation losses due to air and ground attenuation are accounted for, and sound levels are presented in dB(A). The equations developed have been coded for computer processing. M.W.R.

N65-35207*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
FLAT-SPIN RECOVERY SYSTEM

John C. Mc Fall, Jr. [1964] 20 p refs Presented at the Symp on Parachute Technol. and Evaluation, El Centro, Calif., 7–9 Apr. 1964
(NASA-TM-X-54520) CFSTI: HC $1.00/MF $0.50 CSCL 01C

Some application techniques for parachutes used in low-altitude recovery missions have been developed. One of these techniques is illustrated in use with two recovery systems developed to recover a camera pod ejected from the second stage of a NASA Scout booster in a space environment and ablation materials nose cones used on a four-stage boost system. In both these systems the recoverable is decelerated by unaugmented drag in a flat spin prior to parachute deployment. The deployment of the parachute is aided by the centrifugal force of the flat spinning recoverable and a spring forcing the canopy from its container. Author

N65-35212*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRCRAFT PERFORMANCE ON SLIPPERY RUNWAYS IN CROSSWINDS
Jere Cobb and Walter B. Horne [1964] 12 p refs Submitted for Publication
(NASA-TM-X-54560) CFSTI: HC $1.00/MF $0.50 CSCL 01B

The combined effects of crosswind and slippery runways, caused by accumulations of water, snow, ice, and slush, on aircraft ground performance are discussed. Typical runway slipperiness values are shown. It was found that snow-covered pavements are twice as slippery as dry bituminous or concrete pavements; and that ice-covered pavements can be 4 to 16 times as slippery as dry pavements. Water-covered and slush-covered pavements tend to become more slippery as the aircraft ground speed increases, and tires hydroplane when critical fluid depths from approximately 0.1 to 0.4 inches are exceeded. Combined effects of crosswind and slippery runways lead to a loss of directional control, and doubling or tripling of the dry runway stopping distance when hydroplaning occurred. G.G.

N65-35235*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
NASA FLIGHT RESEARCH CENTER HANDLING-QUALITIES PROGRAM ON GENERAL-AVIATION AIRCRAFT
William E. Gray, Jr. 21 Apr. 1964 9 p refs Presented at the AIAA Gen. Aviation Aircraft Design and Operations Meeting Wichita, Kans., 25–27 May 1964
(NASA-TM-X-56004) CFSTI: HC $1.00/MF $0.50 CSCL 01D

The handling qualities criteria that is pertinent to the operations performed by solo pilots in an IFR rough-air environment are under study. The information obtained will lead to realistic means of designing to meet such criteria. It is believed that this program will contribute significantly to the solution of some of the operating problems associated with general-aviation aircraft. The results of the program will be published at a future date. R.W.H.

N65-35258*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SAFE FLIGHT IN ROUGH AIR
Philip Donely [1964] 5 p
(NASA-TM-X-51662) CFSTI: HC $1.00/MF $0.50 CSCL 01B

A narrative report notes that both military and civilian aircraft are designed to perform specific functions, and are usually planned with little regard for the weather in which they will operate. Various government agencies and industrial organizations must, therefore, review the elements of safe flight in rough air; and the knowledge acquired must be coordinated to form the basis for study and implementation of programs to permit aircraft to safely travel through severe turbulence as a matter of routine. M.W.R.

N65-35263*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A STUDY OF HYPERSONIC AIRCRAFT
Douglas E. Wall [1964] 30 p Presented at 4th Natl. Airport Conf., San Francisco, 22–24 Apr. 1964
(NASA-TM-X-51641) CFSTI: HC $2.00/MF $0.50 CSCL 01C

This paper presents the results of a study in which the characteristics of several potential hypersonic aircraft were compared. In this study, candidate fuels were assessed for their application to hypersonic aircraft, several modes of propulsion were considered as well as their flight regions of operation, and an assessment of various classes of hypersonic aircraft was made. The study showed that long-range hypersonic cruise aircraft are sufficiently interesting to warrant more detailed studies. Interceptors employing hydrogen fuel are competitive with those employing hydrocarbon fuels at Mach numbers of 5 to 6. Finally, advancements in the state of the art would provide a more practically sized recoverable booster for takeoff from conventional runways. Author

N65-35284*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
PRELIMINARY RESULTS OF BOUNDARY-LAYER NOISE MEASURED ON THE X-15 AIRPLANE
Eldon E. Kordes and Carole S. Tanner 1 May 1964 13 p refs Presented at the 2d Intern. Conf. on Acoust. Fatigue, Dayton, Ohio, 29 Apr.–1 May 1964
(NASA-TM-X-56003) CFSTI: HC$1.00/MF $0.50 CSCL 01D

A boundary-layer-noise research program is described and some of the preliminary results are presented. Preliminary data on boundary-layer noise obtained from an experimental program with the X-15 airplane show trends similar to data obtained on the Scout missile for comparable flight conditions. In addition, these data show that changes in the noise levels occur as a result of vehicle maneuvers at supersonic speeds. The X-15 program includes instrumentation for obtaining real-time information on the boundary-layer flow as well as boundary-layer noise. Spectrograms of the boundary-layer noise at maximum Mach number and at two portions of flight with nearly constant dynamic pressure are shown. Also, an apparent relationship between sound-pressure level and dyanmic pressure is given, and the ratio of surface pressure to the free-stream dynamic pressure is plotted as a function of Mach number. E.E.B.

N65-35318# North American Aviation, Inc., Columbus, Ohio. Engineering Dept.
DEMONSTRATION PLANNING AND PROGRESS REPORT FOR MODEL T-2B AIRPLANES
W. R. Kniepkamp and D. A. Bomba 26 Apr. 1965 107 p
(Contracts NOw-64-0303-f; NOw-65-0072-f)
(NA-64H-383; AD-465217)

Information is presented which pertains to the demonstration of the model T-2B airplane. Contained in this report are demonstration procedures, schedules, test requirements, and data dealing with the progress of the demonstrations. R.W.H.

N65-35403*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT TESTS OF A ONE-MAN HELICOPTER AND COMPARISON OF ITS HANDLING QUALITIES WITH THOSE OF LARGER VTOL AIRCRAFT
Terrell W. Feistel and Fred J. Drinkwater, III Washington, NASA, Oct. 1965 16 p refs
(NASA-TN-D-3060) CFSTI: HC $1.00/MF $0.50 CSCL 01C

A limited flight test program has been accomplished with a one-man Hiller YROE-1 "Rotorcycle" (gross wt ≅ 500 lb) to help determine criteria for the handling qualities in hover of VTOL aircraft as affected by gross weight. The generally high orders of longitudinal and lateral control power and damping inherent were found to be satisfactory. The high directional control sensitivity, combined with high yaw response in one direction, was considered potentially dangerous. The lateral control power for this craft is approximately the same as that found necessary for satisfactory control with similar damping in tests of two other VTOL aircraft with substantially greater gross weight. Author

N65-35504* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO RANGE INSTRUMENTED AIRCRAFT
L. C. Shelton *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 283-291 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The functions of aircraft in providing communications coverage in support of the Apollo mission, the reasons for using aircraft to supplement land and ship station coverage and factors determining the number of aircraft required are discussed. A sample operational aircraft deployment plan for lunar mission is presented. A functional description of the onboard instrumentation by major subsystems and operator positions is given. Technical problem areas including antenna-size limitations, multipath interference and radio frequency interference and proposed solutions to these problems are treated. Author

N65-35508# Royal Aircraft Establishment, Farnborough (England).
A NON-LINEAR MAXIMISATION PROBLEM ARISING IN THE STUDY OF AIRCRAFT COLLISION RISKS
B. A. M. Piggott Feb. 1965 24 p refs
(RAE-TR-65044)

When two aircraft fly on planned flight paths which bring them close to each other, the risk of collision may be estimated from previous observations of the flight errors in that locality. This report, which considers the case of aircraft on parallel paths separated in a single direction, presents a steepest descent method for solving the non-linear maximisation problem which results from an attempt to use the theory of asymptotically smallest confidence regions to place an upper confidence limit on this estimate. Numerical examples are given and the validity of the method discussed. Author

N65-35658# Army Aviation Materiel Labs., Fort Eustis, Va. Applied Aeronautical Engineering Group.
SUGGESTED REQUIREMENTS FOR V/STOL FLYING QUALITIES
Paul R. Curry and James T. Matthews, Jr. Jun. 1965 56 p
(USAAML-TR-65-45; RTM-37; AD-617748)

This research technical memorandum presents suggestions for a specification on flying and handling qualities requirements for subsonic V/STOL aircraft. In addition to including the ideas of many others, the authors have incorporated two basic suggestions: (1) the use of a pilot rating system (since the ultimate measures of handling qualities are determined by the pilot) and (2) the use of servo-analysis techniques and terms to define quantitative requirements. There are no statistical or quantitative data available to verify the stated requirements in some cases; however, the requirements are based on many different V/STOL research aircraft funded by the U.S. Army and flown by U.S. Army pilots. Author

N65-35670# Douglas Aircraft Co., Santa Monica, Calif.
AIRCRAFT MOTION ANALYSIS
J. A. Thelawder Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Mar. 1965 106 p refs
(Contract AF 33(616)-6460)
(FDL-TDR-64-70; AD-617354)

Coordinate systems and their transformations, equations of motions, and real forces and moments are considered in terms of aircraft motion analysis; these data are intended for use in comparative evaluations and for preliminary design work. Simplified and approximate solutions are presented for various flight conditions. Analytical, computer, and approximate solutions are given for the equations of motion. Instrument readings and fuel slosh are among the special problems considered. Symbols and nomenclature are listed and defined throughout the text. M.W.R.

N65-35690# Lockheed-California Co., Burbank.
EXPLORATION OF HIGH-SPEED FLIGHT WITH THE XH-51A RIGID ROTOR HELICOPTER
William K. Foulke Ft. Eustis, Va., Army Aviation Materiel Labs., Jun. 1965 188 p refs
(Contract DA-44-177-AMC-150(T))
(USAAML-TR-65-25; LR-18374; AD-617966)

A systematic research program to investigate the capability of the rotor system in the XH-51A helicopters is discussed. The primary objective was to attain level flight performance at a true airspeed of 200 knots; 210 knots true airspeed was actually attained with the Compound XH-51A. Analytical studies, design, fabrication and modification, laboratory tests, wind tunnel and ground tests, and research flight tests of two rotor configurations and a compound version of the helicopter were performed. This work is described, and the data obtained with the analyses are presented. Author

N65-35713# Kaman Aircraft Corp., Bloomfield, Conn.
UH-2 HELICOPTER HIGH-SPEED FLIGHT RESEARCH PROGRAM UTILIZING JET THRUST AUGMENTATION Final Report
A. A. Whitfield and W. E. Blackburn Mar. 1965 179 p refs
(Contract DA-44-177-AMC-105(T))
(R-527B; USATRECOM-TE-65-14; AD-616104)

The results of a flight research program conducted to determine the behavior of a fully articulated, servo-flap controlled rotor system at various power levels in high-speed flight are presented. The research aircraft, instrumentation, and test program are described. The test results are discussed and compared with those predicted by analytical study. A standard helicopter was modified by the addition of a jet engine, without afterburner, mounted on the right side of the fuselage for horizontal thrust augmentation. Research flights were conducted up to level-flight true airspeed of 188 knots. Airspeeds limited by retreating blade stall or advancing blade compressibility were established. The effects of density altitude, rotor speed and power, tip speed ratio, thrust augmentation and aircraft gross weight on the limit airspeeds are discussed. It is

concluded that the speed envelope for rotary wing aircraft can be substantially expanded by unloading the main rotor through the application of horizontal thrust augmentation. Author

N65-35724# Ryan Aeronautical Co., San Diego, Calif.
FLEXIBLE WING AIR CARGO GLIDER DELIVERY SYSTEM Final Program Summary Report
N. Sakamoto and G. Cota Ft. Eustis, Va., Army Transportation Res. Command, May 1965 82 p refs *Its* Rept.-648120 (Contract DA-44-177-AMC-868(T))
(TRECOM-TR-65-11; AD-615908)

The results of a flight test program utilizing a flexible wing air cargo delivery vehicle are presented. The objective was to prove the feasibility of this vehicle for the delivery of cargo in a logistic system. Discussed are performance characteristics and handling qualities of both the towed flexible wing and the tow helicopter. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-34903*# Moog Servocontrols, Inc., East Aurora, N. Y.
MAJORITY VOTING MECHANICAL FEEDBACK SERVOACTUATOR FOR THE SATURN S-IV B Final Report
22 Jul. 1965 64 p refs
(Contract NAS8-11634)
(NASA-CR-67194; MR-1031) CFSTI: HC $3.00/MF $0.75 CSCL 09E

The development of two servoactuators intended for thrust vector control in the Saturn S-IV B stage is discussed. These actuators use redundancy by a technique known as majority voting. Through the use of this technique, pertinent output characteristics remain essentially unchanged in consequence to a single failure in any one of three employed channels. The maximum null offset, due to a failure in a single channel, was less than 4%. This compares very favorably with an initially stated goal of less than 5%. Testing and evaluation results indicate that these limits could be maintained in production by the use of existing set-up and test techniques. Simulator tests showed adequate performance for the S-IV B requirements, and performance remained adequate with the introduction of simulated failures. Temperature testing to 275° F also showed no adverse performance characteristics. R.R.D.

N65-34908*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PARAMETRIC ANALYSIS AND CONCEPTUAL DESIGN OF A RADIOISOTOPE-THERMIONIC SPACE POWER GENERATION SYSTEM
L. S. Blair and J. J. Ward Washington, NASA, 1965 21 p refs Presented at the Intern. Conf. on Energetics Sponsored by the ASME, Rochester, N. Y., 18–20 Aug. 1965
(NASA-TM-X-52122) CFSTI: HC $1.00/MF $0.50 CSCL 10B

The effects on efficient system performance of such design variables as the type of radioisotope used, the diode operating temperatures, the fuel block geometry, and the positioning of diodes around the fuel block are considered. A schematic diagram of the power system, and pertinent equations used in the parametric analysis are included. Results showed that, at lower fuel block power densities, system efficiency maximizes at a fuel block length-to-diameter ratio of 1; at high volume power densities, system performance is rather insensitive to length-to-diameter ratio. Heat rejection problems are considered, and methods of cooling the system by direct radiation to space are discussed. The necessity for fins is illustrated, and the relative advantages of side-mounted and end-mounted configurations are shown. System weight calculations are also discussed; it was concluded that, as regards performance level, emitter temperatures of 1800° K or higher, and effective fuel-block volume-power densities of several watts per cubic centimeter are required to achieve system specific weights as low as several hundred pounds per kilowatt (electric) M.G.J.

N65-34910*# Mallory (P. R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science.
RESEARCH AND DEVELOPMENT OF A HIGH CAPACITY NONAQUEOUS SECONDARY BATTERY Third Quarterly Report, Apr.–Jun. 1965
31 Aug. 1965 104 p refs
(Contract NAS3-6017)
(NASA-CR-54732) CFSTI: HC $1.00/MF $0.75 CSCL 10C

Electrochemical behavior in electrolytes employing as solvents, propylene carbonate, butyrolactone, dimethylformamide, and acetonitrile, has been examined. The cathodic reduction of silver chloride and cupric fluoride electrodes has been studied in these electrolytes. The cathodic behavior observed at constant current on various metal surfaces has been studied in propylene carbonate and dimethylformamide solutions of several salts with primary emphasis on lithium salts and on the ability to electrodeposit lithium. Results of preliminary gas chromatographic analysis of propylene carbonate are reported. Author

N65-34911*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
TWO STAGE POTASSIUM TEST TURBINE Quarterly Progress Report No. 15, Nov. 8, 1964–Feb. 8, 1965
E. Schnetzer, ed [1965] 326 p refs
(Contract NAS5-1143)
(NASA-CR-54392) CFSTI: HC $7.00/MF $1.75 CSCL 10A

Assembly, test, and evaluation procedures in the development of a two-stage potassium vapor turbine and its associated components are described. The predicted turbine off-design performance data were obtained, and potassium turbine performance was compared with these data; the overall turbine total-to-total efficiency agreed within 1.5 percentage points between the two methods. The turbine performance parameter digital computer program is described, and tabular data are presented on two-stage potassium turbine performance. In the area of mechanical design, modifications were made to the turbine and to the test facility. Metallography and microhardness evaluation of first stage buckets supported the hypothesis that metal was removed only at the liquid metal interface; no diffusion or subsurface effects were noted. Data on predicted turbine dry vapor flow variations; variations of turbine flow rate and turbine power output with rotative speed for several inlet temperatures; and turbine predicted performance parameter variations under certain conditions are graphically depicted. M.G.J.

N65-34912*# Bendix Corp., Southfield, Mich. Research Labs. Div.
REPLACEMENT OF ELECTRONICS WITH FLUID INTERACTION DEVICES Summary Report

M. H. Cardon 31 Aug. 1965 160 p refs
(Contract NAS3-6201)
(NASA-CR-54758; BRLD-2946) CFSTI: HC $5.00/MF $1.00 CSCL 13G

The report covers the design and analysis of an actuation system that uses fluid circuits instead of electronics. The objective is to develop an all-pneumatic servo actuator with performance equal to the electropneumatic unit but with much more reliability for adverse environments. The system will use a piston-cylinder with rack and pinion that produces 180 degrees rotary output. The system will have a 6 cps bandwidth, 0.2 degrees resolution, and 300 in.-lb stall torque. The working fluid is dry hydrogen with 215 psia supply and 50 psia exhaust. Experimental data on vortex amplifiers for this system are also presented. Author

N65-35072*# Harshaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Div.
DEVELOPMENT OF OPTICAL COATINGS FOR CdS THIN FILM SOLAR CELLS Third Quarterly Report, Jun. 1–Aug. 1, 1965
J. C. Schaefer and E. R. Hill [1965] 21 p
(Contract NAS3-6464)
(NASA-CR-54750) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Suitable glass coatings have been sputtered on CdS solar cell surfaces. Addition of oxygen to the sputtering gases has produced stable films of low reflectance. Efforts are being made to increase the rate of sputtering. A four electrode target electroded on the rear surface of the glass target indicates increased rates. Measurements of spectral reflectance were made on a number of samples, including a silicone primer paint. Apparatus has been assembled for measurement of emittance at solar irradiation power levels. Emittances have been determined for bare cells and a number of other surfaces.
Author

N65-35082# Minnesota Mining and Mfg. Co., St. Paul, Minn. Thermoelectric Products.
300 WATT PORTABLE THERMOELECTRIC GENERATOR Monthly Progress Report, Period Ending 30 Jun. 1965
R. D. Carlton [1965] 5 p
(Contract N600(61533)62758)
(MPR-9, AD-618037)

A 5-couple test module accumulated over 1000 hours of stable performance, and over 400 hours of operation were obtained by a 9-couple module similar to those which will be used in the portable thermoelectric generator. A venturi shroud was fabricated and tested with the burner; it caused increased temperatures of the vaporizer and of the surge chamber. Both parts showed a considerable amount of carbon build-up on the inside. G.G.

N65-35100# General Instrument Corp., Newark, N. J. Thermoelectric Div.
LOW POWER THERMOELECTRIC COMPONENT DEVELOPMENT PROGRAM Final Report, Jul. 1, 1963–Sep. 30, 1964
E. J. Lemanski 1 Mar 1965 135 p refs
(Contract AT(30-1)-2605)
(GIC-2605-3)

Thermoelectric couple evaluation, heat transfer experiments, and insulation tests are presented in a material evaluation and component development program. Several types of bonds for bismuth telluride power producing material were evaluated for stability and physical strength in a 1000 hour test at hot junction temperatures ranging up to 530° F under conditions of moderate vacuum. Experiments were made with a natural convection thermal syphon loop and it was shown that the loop is capable of extracting 1575 Btu/hr of heat from a large area source and directing it to a thermoelectric converter of smaller area with efficiencies greater than 85%. The reduced pressure insulation characteristics of powdered opacified insulation mixtures were measured. Powdered aluminum and ferrosilicon were used as the opacifiers. An A-ferrosilicon insulation mixture was successfully degassed, and its operation was tested in a stable, static vacuum over a period of almost one year at 500° C. C.T.C.

N65-35101*# Monsanto Research Corp., Everett, Mass. Boston Labs.
DEVELOPMENT OF THE DRY TAPE BATTERY CONCEPT Quarterly Report No. 1, 24 Jan.–30 Apr. 1964
Bernard A. Gruber, Joseph J. Byrne, Ralph Kafesjian, Kurt W. Klunder, Theodore J. Wolanski et al 20 May 1964 47 p
(Contract NAS3-4068)
(NASA-CR-54076; MRC-MRB5006Q1) CFSTI: HC $2.00/MF $0.50 CSCL 10C

Expanded magnesium, giving a current density of 1 amp/in.^{2} at a polarization of 0.2 volt, has been tentatively selected as the best anode for combined tape construction. Anode development concentrated on magnesium or aluminum foil, pressed powder, and sprayed metal forms. The preferred method for electrolyte supply is a continuous feed of macrocapsules. Encapsulations of water in thin films of FEP Teflon, Aclar, or aluminum-Mylar laminate are being tested. The organic oxidizer, 2, 4, 6-trichlorotriazine-trione, has been tentatively selected as the cathode active material for the complete tape system because of its high discharge rate. Several lightweight, low-voltage motors have been tested for running the dry tape mechanism by parasitic power. Parasitic operation, with the drive motor consuming about 10% of the output power, (15% motor efficiency) was achieved by combining three silver peroxide tapes, connected in series, with a motor and a variable speed transmission.
Author

N65-35113*# Sperry Gyroscope Co., Great Neck, N. Y. Inertial Div.
DEVELOPMENT AND FABRICATION OF ADVANCED DESIGN RATE GYRO Monthly Progress Report No. 1, 19 Jun.–31 Jul. 1963
14 Aug. 1963 9 p
(Contract NAS8-5464)
(NASA-CR-67244; CA-4211-0194) CFSTI: HC $1.00/MF $0.50 CSCL 13G

It is reported that the experimental gyroscope model was assembled and that the signal preamplifier breadboard was designed and assembled. It is also reported that the experimental model utilizes conventional slip rings and .003 in. thick aluminum transducer diaphragms. The advanced model layout and a circuit schematic of the signal preamplifier are included. C.T.C.

N65-35186# Argonne National Lab., Ill.
EVALUATION OF A THERMIONIC ENERGY CONVERTER USING FILM-BOILING LIQUID METAL
A. J. Ulrich May 1965 27 p refs
(Contract W-31-109-ENG-38)
(ANL-7039) CFSTI: $1.00

A thermionic energy-conversion diode is evaluated which uses a liquid metal as the electron collector. Liquids such as cesium, rubidium, or potassium and their alloys, are separated from the hot emitter by the vapor film produced in film boiling. Such a vapor film would maintain electrical separation if the

emitter became warped due to radiation damage, thus greatly improving the reliability of the in-core thermionic diode. It is found that stable film boiling occurs for ranges of emitter temperatures and of cesium and potassium vapor pressures which are appropriate for thermionic diodes. The typical thermionic, series-connected, fuel-element geometry can be used in a film-boiling liquid-metal design to produce power in the zero-g field of space. Author

N65-35215*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CHARACTERISTICS OF SOLAR CONCENTRATORS AS APPLIED TO SPACE POWER SYSTEMS
O. K. Houck and A. R. Heath, Jr. [1964] 34 p refs Presented at the SAE-ASME Natl. Aeron. Meeting, New York, 27–30 Apr. 1964
(NASA-TM-X-54627) CFSTI: HC $2.00/MF $0.50 CSCL 10B

An analysis is presented of current solar concentrator types when integrated into complete space power systems with various electrical conversion methods. Concentrator designs such as inflatable-rigidized, petal, one-piece, and Fresnel are treated in the paper and their size, weight, and packaging characteristics, when combined with dynamic and static conversion schemes, are illustrated. Information presented in the paper provides insight into the selection of concentrator designs for space power applications. Author

N65-35247*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF IMPURITIES ON RADIATION DAMAGE OF SILICON SOLAR CELLS
Joseph Mandelkorn, Lawrence Schwartz, Jacob Broder, Harold Kautz, and Robert Ulman Washington, NASA, 1964 10 p refs
(NASA-TM-X-52007) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Solar cells were made from silicon ingots containing either boron, aluminum, indium, gallium, or gadolinium as acceptors. Results were obtained from a series of 10-MeV proton bombardments of the various boron-doped Czochralski cell groups. Several of the 10- to 20-ohm-cm groups containing acceptor elements other than boron were subjected to the series of 10-MeV proton bombardments. A relative long wavelength collection efficiency method was used to measure diffusion lengths of proton-bombarded cells. The aluminum-doped cells preserved considerably longer base-region diffusion lengths after each bombardment than cells doped with an equal concentration of boron. It was shown that a relation exists between the element used as an acceptor or donor in the base region of solar cells and the diffusion length preserved in the base region after bombardment. R.W.H.

N65-35255*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIMITS ON COLLISIONLESS MODEL OF THERMIONIC CONVERTER
C. M. Goldstein 27 Feb. 1964 8 p refs Submitted for Publication
(NASA-TM-X-51531) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Current–voltage characteristics for gaseous thermionic diodes were computed, by using the Langmuir space charge theory modified to include both ions and electrons. Figures are included to show the limiting potential distributions defining the model for electron-rich and ion-rich emissions; the beta parameter; and the limiting values of alpha and beta. Equations are given to support the illustrative data. M.G.J.

N65-35402*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF A JET CONDENSER FOR SPACE POWER
Robert J. Platt, Jr. Washington, NASA, Oct. 1965 35 p refs
(NASA-TN-D-3045) CFSTI: HC $2.00/MF $0.50 CSCL 10B

Results of a ground-based exploratory investigation of a jet condenser for space power systems, which utilizes water as the working fluid, are reported. Presented are data on wall measurements, flow stability, condensation length, power requirements, and pressure augmentation. Condensation length was affected by the flow variables and nozzle configuration. An empirical parameter, based on the flow conditions and nozzle area ratio, was found to correlate roughly the experimental condensation-length data. The jet condenser offered a means of pressure augmentation of the condensate through the expenditure of pumping power. A relatively large ratio of steam nozzle area to water nozzle area was found to be more efficient in that pressure augmentation was accomplished with less pumping power required per unit steam flow; however, a large nozzle area ratio increased the possibility of developing regular fluctuations of the flow, accompanied by oscillations of the condensation length. Results indicate that the jet condenser investigated (inner vapor nozzle, outer liquid nozzle) is feasible for space application although the range of stable operation is limited. S.C.W.

N65-35406*# TRW Systems Group, Redondo Beach, Calif.
A STUDY TO DEVELOP A LOW TEMPERATURE BATTERY SUITABLE FOR SPACE PROBE APPLICATIONS Final Report
M. R. Unger [1964] 302 p refs
(Contract NAS3-6018)
(NASA-CR-54737) CFSTI: HC $7.00/MF $1.75 CSCL 10A

This study examines in detail the practicability of heating spacecraft batteries to extend their capabilities into the ultra-low temperature space applications. Several acceptable design concepts are established using systematic evaluations of batteries, heat sources, thermal controls and mission interfaces. Potential applications are determined and new technology required for hardware design is defined. A development plan for new technology is presented. Preliminary heated battery designs for two types of thermal requirements are investigated and model analyses are presented detailing technical performance. Author

N65-35408*# Thiokol Chemical Corp., Huntsville, Ala.
STANDARD COMPARISON TEST PROCEDURES FOR INITIATOR OUTPUT
R. M. Latta, B. B. Stokes, and G. E. Webb Apr. 1965 111 p refs
(Contract NAS8-11551)
(NASA-CR-67333; U-65-4461) CFSTI: HC $4.00/MF $0.75 CSCL 19A

Procedures for comparing, characterizing, developing, and quality control testing of initiator devices used to produce a hot flash of relatively low brisance for initiation of pyrotechnic materials are described. These procedures can also be used to characterize the output of a particular initiator by obtaining the total heat output and the closed bomb pressure. G.G.

N65-35557# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF AN IMPROVED THERMIONIC ENERGY CONVERTER Final Technical Report

May 1965 85 p
(Contract AT(30-1)-3429)
(NYO-3429-4) CFSTI: $4.00

Feasibility of thermionic converters which operate with cesium in the vapor state is demonstrated. This successful departure from liquid reservoir requirements is of particular interest for space flight applications. In this vapor device, operating pressure can be maintained over long periods of time due to the fact that cesium vapor can be adsorbed on the internal surfaces. A true two-temperature converter is possible which has no temperature higher than emitter temperature and no temperature lower than that of the collector. Cesium pressure can be maintained at the optimum value for a wide range of emitter temperatures without requiring external control. J.M.D.

N65-35600# Harshaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Div.
INVESTIGATION OF CdS THIN-FILM SOLAR CELLS Technical Report, Nov. 1963–Dec. 1964
Wright-Patterson AFB, Ohio. AF Aero Propulsion Lab., Feb. 1965 120 p refs
(Contract AF 33(615)-1248)
(AFAPL-TR-65-1; AD-613187)

Research and development of front wall, thin film, flexible, light weight CdS solar cells has continued. A one square foot array has shown a power to weight ratio of about 35.0 watts/lb., with an overall area utilization factor of over 0.80. Exposure of cells to electron, proton, and Cobalt 60 radiation has shown little or no damage. Studies on the formation of the CdS layer indicate a higher degree of preferred orientation and crystallite size as the substrate temperature increases. Crystallites of 100 micron dimension have been observed. Optical measurements on the p-layer confirm the conclusion that the barrier layer is a highly conducting copper sulfide. Overlayers of SiO deposited on the cell decrease the rate of water vapor degradation, but mechanical imperfections restrict the thickness of the deposited layer. Theoretical analysis of the experimental data show serious and probably insurmountable problems with application of either a surface state or trap model for the CdS solar cell. Author

N65-35637# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Space and Defense Sciences Dept.
DESIGN OF HYDROGEN-OXYGEN CAPILLARY TYPE FUEL CELL Quarterly Technical Progress Report, 1 Feb.–30 Apr. 1965
R. M. Casper et al 15 May 1965 17 p
(Contract AF 33(615)-1185)
(QTPR-6; AD-615310)

Specifications were completed for the major system components, equipment environmental requirements, and the system qualification test. A new shutter design, and design and fabrication of a new shutter forming tool were completed along with the evaluation of cell plate fabricating methods. Die casting, chemical milling, and forging were investigated. The plate design for the 1965 prototype module has almost been completed. Other design studies and materials tests were also conducted. R.W.H.

N65-35721# Union Carbide Corp., Parma, Ohio. Parma Research Center.
THIN FUEL CELL ELECTRODES Final Report, 1 Jun. 1963–31 May 1964
M. B. Clark, W. G. Darland, G. E. Evans, and K. V. Kordesch [1964] 78 p
(Contract DA-36-039-AMC-02314(E))
(Rept.-4; AD-615160)

Thin electrodes consisting of a porous metal backing and a plastic-bonded carbon layer have been fabricated and tested. Electrode processing variables (type of backing, carbon, catalysts), and operating parameters (current density, temperature) have been screened and evaluated in a partial factorial testing program. Electrodes selected from the superior test groups have been built into larger cells for the determination of output and operating life characteristics. Author

N65-35742# General Motors Corp., Anderson, Ind. Delco-Remy Div.
ZINC ELECTRODE INVESTIGATION Quarterly Technical Progress Report, 1 Jan.–1 Apr. 1965
J. J. Lander, J. A. Keralla, and R. S. Bogner 15 Apr. 1965 50 p
(Contract AF 33(615)-1583)
(QTPR-3; AD-614119)

Auxiliary electrodes attached to AgO electrodes through a diode in a test cell appear to eliminate excessive pressures occurring through H_2 liberation. The use of acicular (needle-like) particle shapes of zinc-oxide are detrimental to cycle life. The zinc-oxide KADOX-15 appears to be most satisfactory for use in cells in this program. The repeat tests on surfactants using 1%, 3%, 5% additions in the negative material indicate that additions larger than 1% are detrimental to cell performance. A new cell case and cover mold is completed, and test units of celcon moldings are being prepared for heat sealing techniques. Author

N65-35755# Harshaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Div.
RESEARCH ON PHOTOVOLTAIC CELLS Quarterly Progress Report, 1 May–31 Jul. 1964
Donald J. Harvey and Norman E. Heyerdahl Wright-Patterson AFB, Ohio. Aerospace Res. Labs., Aug. 1964 26 p refs
(Contract AF 33(657)-7916)
(QPR-5; AD-608468)

Coevaporated films of CdTe are examined in a study of the fabrication and principal features of thin film solar cells. The reproducibility of CdTe films formed by coevaporation was also studied. Apparatus was designed and constructed to test thin film solar cell output. Electrical properties were determined for both glass and Mo substrates, and the Hall effect and resistivity were measured for the films on glass. The reproducibility of CdTe solar cells is included. C.T.C.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-34775# Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH IN SPACE
13 Sep. 1865 31 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 4, Jul.–Aug. 1965 p 481–499
(JPRS-31958; TT-65-32452) CFSTI: $2.00

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N65-34776 Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF REACTIVITY IN SPACE MEDICINE

V. V. Parin, P. V. Vail'yev, and V. Ye. Belay *In its* Soviet Res. in Space 13 Sep. 1965 p 1–16 refs (See N65-34775 23-04)

The influence of environmental factors such as diet, temperature, barometric pressure, gas composition of inhaled air, physical, neuro-psychic factors etc. upon the individual physiological reactivity of animals and man is investigated. Changes in the reactivity of albino mice, rats, rabbits, and dogs were produced by administering various pharmacological agents prior to subjecting the animals to G-forces, and the optimum dosage of each agent for increasing significantly constitutional resistance to the effect of G-forces was studied. The results were encouraging and indicate that tolerance to the effects of G-forces can be increased by changing constitutional reactivity by means of pharmacological agents. Results also indicate that under the influence of G-forces there are changes in the sensitivity of an organism to a number of pharmacological agents (narcotics, cardiac glycosides, vasodilating and vasoconstrictive agents, and others). L.S.

N65-34777 Joint Publications Research Service, Washington, D. C.

REACTIONS OF THE CARDIOVASCULAR AND RESPIRATORY SYSTEMS OF COSMONAUTS UNDER CONDITIONS OF ORBITAL FLIGHT IN THE SPACECRAFT "VOSKHOD-1"

P. V. Vasil'yev, A. D. Voskresenskiy, I. I. Kas'yan, D. G. Maksimov, I. D. Pestov et al *In its* Soviet Res. in Space 13 Sep. 1965 p 17–28 refs (See N65-34775 23-04)

Electrocardiogram (EKG), phonocardiogram (PKG), kinetocardiographic, and seismocardiographic (SKG) data on cosmonauts were processed from telemetric recordings obtained from Voskhod-1 to determine the reactions of the cardiovascular and respiratory systems of the cosmonauts during the orbital flight. The dynamics of pulse and respiration rates, and of EKG and SKG indices during flight revealed some individual distinctions, but on the whole were similar to the dynamics of analagous indices of cosmonauts in previous flights, and indicated no disturbances in cardiovascular and respiratory systems. Changes in R-R variation coefficients and respiratory pauses from orbit to orbit generally coincided in time and direction, and the dynamics of pulse fluctuation and time related characteristics of the respiratory cycle appear to reflect changes in the cosmonauts general condition during the process of adaption to orbital flight and to weightlessness. L.S.

N65-34868# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF GAMMA-RAYS AND VIBRATION ON THE PHYSICOCHEMICAL PROPERTIES OF RED BLOOD CORPUSCLES

Yu. A. Kriger and Ye. A. Sverdlova 5 Aug. 1965 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 160, no. 3, 1965 p 713–716

(FTD-TT-65-585/1+2+4; AD-619329)

The effect of gamma-radiation and vibration on dielectric and osmotic properties, and the cation balance of erythrocytes were investigated. Experiments were conducted on whole human blood and on 25% suspension of erythrocytes. The results of measuring dispersions of ohmic and capacitance components of summary erythrocyte resistance showed that neither the irradiation of erythrocytes in whole blood by a dosage of 80 kr, nor the subsequent effect of vibration produced any changes in characteristics in comparison to the control. In the experiments of irradiating and vibrating suspensions of erythrocytes in a physiological solution there was noticed a divergence in values of volumetric indices, observed visually and calculated theoretically. Measurement of a potassium yield from the erythrocytes was conducted within 5 to 7 hours after the effect of radiation and subsequent vibration. It was evident that with an increase in radiation dosage, the yield of potassium from the erythrocytes increased considerably. It was shown that vibration does not intensify the yield of potassium in the control or in the experiment. R.W.H.

N65-34895# Indiana Univ., Bloomington.

THE INFLUENCES OF SEPARATIONS AND LUMINANCES OF NEIGHBORING INDUCING FIELDS UPON THE FOVEAL CRITICAL FLICKER FREQUENCY

Constantine Anthony Ricciardi (M.S. Thesis) Sep. 1965 50 p refs

(AD-618697)

The effects of non-contiguous inducing fields, i.e. segmented fields, of increasing light intensity upon the foveal fusion frequency threshold are investigated. Emphasis is placed on the determination of: (1) how, and at what intensity levels, the maximal critical fusion frequency (C.F.F.) peaks shift; (2) changes in the magnitude of the C.F.F. maxima; and (3) the rate at which changes in C.F.F. diminish. An analogy is made between the psychophysical results of the study and the findings of electrophysiological investigations concerning lateral inhibitory interaction within the retina. D.T.

N65-34941 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF SPACEFLIGHT FACTORS ON PHYSIOLOGICAL PROCESSES IN THE GERMINATION OF SEEDS OF CERTAIN HIGHER PLANTS

L. K. Gordon, T. S. Kanter, V. V. Antipov, and V. G. Vysotskiy *In its* Cosmic Res., Vol. 3, No. 3, 18 Aug. 1965 p 215–224 refs (See N65-34925 23-30)

It has been shown that the complex of factors operating in spaceflight influences the meristem tissues of plant embryos. The changes that occur in these tissues do not always disturb the germination and sprouting of the seeds. Some increase in polyphenol oxidase and cytochrome oxidase activity was detected histochemically in experimental seeds. Author

N65-34942 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF SPACEFLIGHT CONDITIONS ABOARD THE VOSTOK 5 AND VOSTOK 6 SPACECRAFT ON THE PRIMORDIAL-ROOT CHROMOSOMES OF EMBRYOS IN SEEDS OF CERTAIN HIGHER PLANTS

N. L. Delone, N. A. Rudneva, and V. V. Antipov *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 225–238 refs (See N65-34925 23-30)

A study was made of the influence of spaceflight conditions on the chromosomes of a number of higher plants whose seeds had been carried on the Vostok 5 and Vostok 6 spacecraft. Some increase in the percentage of chromosome was detected in the radicle cells, together with changes in the ratios of the various types of rearrangements as compared with the control. Author

N65-34943 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STUDY OF PHAGE PRODUCTION OF E. COLI K-12 (λ), INDUCED UNDER THE CONDITIONS OF THE FLIGHTS MADE BY THE VOSTOK 3 AND VOSTOK 4 SPACECRAFT

N. N. Zhukov-Verezhnikov, I. N. Mayskiy, A. P. Pekhov, N. I. Rybakov, G. P. Tribulev et al *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 239–245 refs (See N65-34925 23-30)

A statistically reliable inducing effect of spaceflight factors on the lysogenic bacterium E. coli K-12 (λ) was detected in experiments on the spacecraft Vostok 3 and Vostok 4. The effect was more pronounced in the biological specimens exposed on the spacecraft Vostok 3. Author

N65-34944 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE BIOLOGICAL EFFECT OF SPACEFLIGHT FACTORS USING LYSOGENIC BACTERIA IN EXPERIMENTS ON THE VOSTOK 5 AND VOSTOK 6 SPACECRAFT

N. N. Zhukov-Verezhnikov, I. N. Mayskiy, A. P. Pekhov, V. V. Antipov, N. I. Rybakov et al *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 246–251 refs (See N65-34925 23-30)

The results of a study of the biological effects of spaceflight factors aboard the Vostok 5 and Vostok 6 spacecraft are presented. It is established that the extent to which phage formation is induced in these experiments was almost the same as in the flights of Vostok 3 and Vostok 4. β-mercaptopropylamine is capable of blocking the formation of induced phage particles and lowering the level of the spontaneous lysogenic reaction under the conditions prevailing in spaceflight. Author

N65-35006# Association Claude Bernard, Paris (France).

RESEARCH RELATING TO THE STUDY OF RADIATION EFFECTS ON THE FUNCTIONS AND ENZYMATIC POTENTIAL OF PLATELETS [RECHERCHE SUR L'ETUDE DES EFFETS DES RADIATIONS SUR LES FONCTIONS ET L'EQUIPEMENT ENZYMATIQUE DES PLAQUETTES] Annual Report, 1963–1964

J. Caen Brussels, EURATOM, 1965 21 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-019-63-3-BIOF)
(EUR-2438.f) CFSTI: HC $1.00/MF $0.50

After exposure of the platelet-rich citrated plasma to X-ray doses varying from 50 to 800 R, the following results were obtained: no change in the number of platelets; and a few morphological alterations in 2–10% of the cells, even after a 50 R dose. Author

N65-35016# Joint Publications Research Service, Washington, D. C.

THE BIOLOGICAL ACTION OF NEUTRON RADIATION

A. A. Gorodetskiy, ed. 2 Sep. 1965 135 p refs Transl. into ENGLISH of the book "Biol. Deystviye Neytronnogo Izlucheniya" Kiev, Naukova Dumka, 1965
(JPRS-31822, TT-65-32317) CFSTI: $4.00

A compilation of experimental material on the biological action of fast neutrons on animals and microorganisms is presented. The effects of neutron radiation on the cardiovascular and blood-producing systems, on certain physical-chemical properties of blood, and on the functional condition of the thyroid gland and the cortex of the suprarenal gland are examined. Problems concerning the techniques of irradiation and tissue dosimetry with a nuclear reactor are also discussed. Bibliographic information is included for each article. M.G.J.

N65-35017# Joint Publications Research Service, Washington, D. C.

BLOOD REGENERATION FOLLOWING LOSS OF BLOOD IN ANIMALS ACCLIMATIZED TO HIGH ALTITUDE

A. A. Almerekova 31 Aug. 1965 9 p Transl. into ENGLISH from Sov. Zdravookhr. Kirgizii (Frunze), no. 2, Mar.–Apr. 1965 p 21–26
(JPRS-31781, TT-65-32276) CFSTI: $1.00

The effect of hypoxia on the organism was studied, and the importance of reduced partial pressure of oxygen on the formation of hemopoietins in acclimatized animals subject to hemorrhaging was examined. Investigations involved 14 dogs, acclimated to an altitude of 3200 meters for a month, and 8 unacclimated animals. The hemoglobin level, erythrocytes, reticulocytes, and hemopoietin content were determined, and controls were established to reveal characteristics of red blood regeneration after blood loss. The experiments are described, and data on the various tests are given. From these findings it was assumed that increased hemopoietic activity of blood serum, stimulating hemopoiesis, indirectly induces improvement in the course of oxidative processes; and that an increase in the hemopoietin level under high altitude conditions is a protective response of the organism against oxygen starvation. M.G.J.

N65-35020# California Univ., Livermore. Lawrence Radiation Lab.

NEUTRON ACTIVATION OF THE TERRESTRIAL ENVIRONMENT AS A RESULT OF UNDERGROUND NUCLEAR EXPLOSIONS

Yook C. Ng 22 Jun. 1965 42 p refs
(Contract W-7405-ENG-48)
(UCRL-14249) CFSTI: $2.00

The neutron activation products induced in the terrestrial environment following underground nuclear explosions are identified, and estimates for their production are presented. In the course of this effort all known stable nuclides were considered as parent materials for the more common neutron activation reactions—(n,γ), (n,2n) (n,p), and (n,α)—which result in the production of activities having a half-life of one day or greater. The induced radionuclides so identified are numerous and widely distributed in atomic number. Radionuclides of very short half-life were thought to lack the potential to contribute significantly to the internal dose and were not considered. Estimates for induced radionuclide production in granite are presented, and the activation products produced in substantial quantity are identified. Adequate estimates can be made for production in rocks differing in composition based on parent element concentrations and yields calculated for granite. When the fission-to-fusion ratio is 0.01, activation products from rock or soil will generally be comparable to fission products in activity if essentially all the fusion neutrons are released to the environment, and will be less prominent if the neutrons released are reduced through the use of nonactivating neutron absorbers. Author

N65-35035# Army Medical Research and Nutrition Lab., Denver, Colo.

THE TRACE MINERAL LOSSES IN SWEAT

C. Frank Consolazio, Richard A. Nelson, Le Roy O. Matoush, Ronald C. Hughes, and Paul Urone (Colorado Univ.) 18 Aug. 1964 17 p refs
(Rept.-284; AD-447382)

The results of this study show that considerable quantities of the trace minerals, including zinc, selenium, copper, cobalt, iodine, strontium, molybdenum, nickel, lead and chromium, are excreted in sweat, under conditions that produce profuse sweating. These losses are extremely important since they reflect losses that should be included in balance studies, which would greatly aid in evaluating more realistically the minimal daily requirements. As in previous studies, the excretion of these trace minerals in sweat decreases appreciably during acclimatization to hot environments. Author

N65-35036# School of Aerospace Medicine, Brooks AFB, Tex.
THE VALIDITY OF FLIGHT BLOOD PRESSURE DATA
James Roman, James P. Henry, and John P. Meehan (Southern Calif. Univ.) May 1965 18 p refs
(SAM-TR-65-27; AD-469295)

The validity of the acoustic method of blood pressure determination was checked on a pilot in the course of one mission in an NF-100-F jet fighter aircraft, by means of simultaneous arterial catheter data collection. Mean absolute error for both systolic and diastolic pressures was less than the mean respiratory variation in blood pressure for the 75 readings obtained. Author

N65-35045# Air Force Systems Command, Wright-Patterson AFB, Ohio. Biomedical Lab.
SKIN TEMPERATURE CHANGES CAUSED BY INTENSE DIFFUSE THERMAL RADIATION
W. C. Kaufman Apr. 1965 14 p refs Presented at the 21st Aerospace Med. Panel Meeting, Lisbon, 17–22 Sep. 1964
(AMRL-TR-65-64; AD-616698)

The rates at which critical levels of temperature are attained by the natural human skin exposed to intense thermal radiation have been studied using infrared quartz lamps. Early studies were done in a static aircraft in which a human subject in the cockpit was exposed to thermal radiation produced by 1,000 infrared lamps. Later, for more definitive studies, a radiometer and an infrared source, having irradiances that could be controlled between 0.06 and 0.7 cal/cm^2 sec, were constructed so that precise surface temperature measurements could be made during exposure to various intensities of thermal radiation. Spectra were varied by filtering through different substances. The whole dorsum of the hand was exposed and intradermal and subdermal temperatures were recorded from 0.13 mm thermocouples threaded through the skin. The rate of temperature rise is a function of the irradiance and the spectral characteristics of the source, the optical filter, and the skin. Plate glass, plexiglass, and a laminated glass aircraft windshield attenuated the temperature response by 0.3, 0.5, and 0.7 respectively in comparison with the unfiltered energy. These data have extensive civil defense, fire fighting, and military application. Author

N65-35104*# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
AUDITORY FREQUENCY THRESHOLD COMPARISONS OF HUMANS AND PRE-ADOLESCENT CHIMPANZEES
Donald N. Farrer and Merle M. Prim Jun. 1965 15 p refs
(NASA Order R-25)
(NASA-CR-67297; ARL-TR-65-6) CFSTI: HC $1.00/MF $0.50 CSCL 06C

Upper limits of hearing at 80 decibels (db) were established for five chimpanzees (age range: 4 to 6 years) and 90 humans (age range: 5 to 35 years). It was concluded that pre-adolescent chimpanzees have the ability to respond to higher frequencies than pre-adolescent children, and the diminution in human perception of high frequencies as a function of age was confirmed. Statistically significant decrements in hearing were found at 10-year intervals between 5 and 35 years of age. Trend analysis of these data suggested that the diminution in high frequency perception was linear and the variability appeared Gaussian. Author

N65-35105*# General Technical Services, Inc., Cleveland, Ohio.
[GENERAL DYNAMICS OF PHYSICAL–CHEMICAL SYSTEMS IN MAMMALS] Fourth Quarterly Progress Report, May 21–Aug. 20, 1965
A. S. Iberall 27 Aug. 1965 12 p refs
(Contract NASw-1066)
(NASA-CR-67225) CFSTI: HC $1.00/MF $0.50 CSCL 06P

Work continues on the mathematical modeling of the hydrodynamics of the arterial system, and attempts are underway to expose active normal tissue in guinea pigs so that microcirculation can be observed. Window techniques and fiber optics are being considered for the latter studies. Experiments also deal with blood constituent dynamics and temperature differences between arterial and venous flow. A paper is presented on the dynamics of metabolic control in mammalian microcirculation. M.W.R.

N65-35107*# AVCO Corp., Tulsa, Okla.
STUDY OF THE CORRELATION BETWEEN LINEAR ENERGY TRANSFER AND RELATIVE BIOLOGICAL EFFECTIVENESS First Quarterly Report, 1 Jul.–1 Oct. 1963
[1963] 31 p Prepared jointly with Okla. Univ. Res. Inst.
(Contract NASw-782)
(NASA-CR-67239) CFSTI: HC $2.00/MF $0.50 CSCL 06R

Procedures are described for an experiment to instrument the physical parameters, linear energy transfer (LET) and absorbed dose, and observe their lethal effect on yeast. The procedure is to establish a relative biological effectiveness of one for the yeast with 200 KVCP X-rays; quantitate the absorbed dose using a tissue equivalent ionization chamber; and, holding dose constant, vary and measure the LET by changing types of radiation and their incident energies. Thus, two contributing factors to cell death are measured and the amount of killing is observed through the decrease in the yeast's viability. The parameters, rad dose, LET, and cell viability, must be known to perform the experiment. To establish cell viability, yeast in a compacted mass are irradiated, the cell mass sectioned at various depths, and plate counts made of each section. To establish LET, an instrument measures energy transfer within the dimensions of a single cell to the surrounding medium by an ionizing particle. To establish dose, an instrument measures absorbed dose at a macroscopic point within a medium in units of ergs per gm. Experiment results with a compacted yeast cell mass indicate that with adequate control the technique is successful. R.N.A.

N65-35110*# Naval School of Aviation Medicine, Pensacola, Fla.
CHANGES IN SPONTANEOUS ACTIVITY AS A MEASURE OF SENSITIVITY TO ROTATION IN THE WHITE RAT
Arnold Eskin and David C. Riccio 11 Jan. 1965 14 p refs
Joint report with NASA
(NASA Order R-93)
(NASA-CR-67253) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Fifty-six unrestrained rats were individually exposed to a rotation speed between 0–18 rpm. Their activity was measured using a fourpoint scale: 0) no activity, 1) grooming and sniffing, 2) moderate running, and 3) rapid running. Amount of activity decreased as a function of rotation speed from 6 to 14 rpm, where it reached a lower limit plateau. Rate of decline within this speed range was also directly related to velocity. Postrotation activity was suppressed up to five minutes. The rats showed considerable sensitivity to Coriolis stimuli generated during constant speed of rotation. A relationship was found between duration and magnitude of stimulation. These findings are encouraging for the use of behavioral methods in studying sensitivity to motion. Author

N65-35116*# Public Health Service, Phoenix, Ariz. Technology Branch.

COMPARATIVE LEVELS AND SURVIVAL OF NATURALLY OCCURRING MICROORGANISMS DEPOSITED ON SURFACES THROUGH HANDLING AND AERIAL FALLOUT
A Preliminary Report

Martin S. Favero, John R. Puleo, James H. Marshall, and Gordon S. Oxborrow 9 Aug. 1965 20 p refs *Its* Rept.-8 (NASA Order R-137)
(NASA-CR-67267) CFSTI: HC $1.00/MF $0.50 CSCL 06F

Studies were performed to determine the death rates of naturally occurring microorganisms deposited on surfaces of stainless steel and electronic components by handling and aerial fallout. Experiments were carried out in both spacecraft assembly areas in operation and in laboratory environments. Stainless steel strips were exposed to industrial clean room and laboratory environments for a period of time and then covered with sterile aluminum foil. Assays were performed immediately before and at intervals up to 8 weeks after covering. The results indicated clearly that the total aerobic mesophilic population decreased by approximately 50 percent after 2 weeks. Non-spore-forming bacteria were reduced by 80 percent after 2 weeks. The aerobic sporeformers, molds, and actinomycetes did not appear to be affected. In another series of tests sterile stainless steel strips were contaminated by handling, placed in sterile containers and assayed at intervals up to 4 weeks. After 2 weeks, less than 10 percent of the microbial population survived and after 4 weeks, 1 to 2 percent survived. Author

N65-35150# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM BIOFIZIKA, (BIOPHYSICS), VOLUME X, NO. 4, 1965

30 Sep. 1965 24 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 10, no. 4, 1965 p 619–624, 641–644, 699–700, 704–707
(JPRS-32209; TT-65-32699)

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N65-35151# Joint Publications Research Service, Washington, D. C.

RELATIONSHIP OF THE PROBLEM OF MITOGENETIC RADIATION TO CURRENT TRENDS IN BIOPHYSICAL RESEARCH

A. A. Gurvich *In its* Transl. from Biofiz., (Biophys.), Vol. X, No. 4, 1965 30 Sep. 1965 p 1–7 refs (See N65-35150 23-04)

A general discussion of data and theories pertaining to mitogenetic radiation and of data gathered and analyzed in contemporary biophysical research is presented. The article points out the common interpretation of individual phenomena (the free radical mechanism of chemiluminescence) and the similarity between certain general hypotheses regarding the molecular substrate of living systems and the corresponding concepts and constructs developed by A. G. Gurvich. R.N.A.

N65-35152 Joint Publications Research Service, Washington, D. C.

SUBSTRUCTURAL ORGANIZATION OF THE GRAVITATION ORGAN OF THE PIGEON UTRICLE

Ya. A. Yinnikov, V. I. Govardovskiy, and I. V. Osipova *In its* Transl. from Biofiz., (Biophys.), Vol. X, No. 4, 1965 30 Sep. 1965 p 8–12 refs (See N65-35150 23-04)

The results of an electron microscopic study of the pigeon utricle are presented. It was found that the avian utricle contains both cylindrical ciliated cells of the second type and urceiform cells of the first type. Cells of the first type are consistent in structure and are equipped with stationary stereoliths, whose distal ends bear the otolithic membrane and otoliths, and a single polar mobile kinocilium. The innervation of these cells differs greatly. Ciliated cells of the second type are in contact with small dark and light nerve endings. Cells of the first type are in contact with cyathiform nerve endings over their entire plasma membrane, except for the apex. Two to five cells are usually enclosed in a single giant neural cup. The appearance of such giant cyathiform synapses, which innervate several ciliated cells simultaneously, is probably a new evolutionary adaptation in birds and is associated with their ability to move freely in the air. R.N.A.

N65-35153 Joint Publications Research Service, Washington, D. C.

PARTICIPATION OF PHOSPHOPROTEINS IN ACTIVE ION TRANSPORT IN RAT-CORTEX SECTIONS

B. A. Tashmukhamedov and N. P. Lisovskaya *In its* Transl. from Biofiz., (Biophys.), Vol. X, No. 4, 1965 30 Sep. 1965 p 13–16 refs (See N65-35150 23-04)

A study was conducted on the renewal rate of phosphoprotein (PP) phosphorus in rat cortex sections with the ion pump functioning under various conditions. Varying pump function activation or attenuation was achieved by altering section incubation conditions, by replacing the Na^+ in the incubation medium with Li^+ or chlorine, and by exposure to cardiac glucosides. Experimental results show that there is a correlation between the rate of PP metabolism and the activity of ion transport in intact cortical cells. A PP fraction metabolized at a definite rate apparently participates in active ion transport as a protein ion carrier. This conclusion is in agreement with hypotheses previously advanced. R.N.A.

N65-35154 Joint Publications Research Service, Washington, D. C.

BIOELECTRIC PHENOMENA IN SINGLE-CELLED ORGANISMS

N. N. Kokina *In its* Transl. from Biofiz., (Biophys.), Vol. X, No. 4, 1965 30 Sep. 1965 p 17–21 refs (See N65-35150 23-04)

Three different types of electrical response reactions to stimulation were observed in *Opalina ranarum*. The most frequently encountered response was a change in periodic activity, either inhibited or stimulated. The second type of reaction consists of depolarization and subsequent slow restoration of potential. The third reaction consists of a burst of fast low voltage impulses. These reactions were compared with response reactions of other single cell organisms, myxomycetes, and plants. From this comparison it was hypothesized that the electrical reactions to stimulation of these organisms have certain common characteristics: the dependence of potential shape and amplitude on stimulus strength, the slow development of potentials with time, and the appearance under certain conditions of faster potentials exhibiting no marked dependence on stimulus strength, but differing greatly from the typical neuromuscular spike. Excitable structures at this stage of development exhibit slow progressive reactions of the receptor membrane and a capacity for fast electrical reactions. Subsequent development gives the latter the form of the fast action currents of nerve and muscle cells. R.N.A.

N65-35262*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

HYPOXEMIA INDUCED BY SUSTAINED FORWARD ACCELERATION IN PILOTS BREATHING PURE OXYGEN IN A FIVE POUNDS PER SQUARE INCH ABSOLUTE ENVIRONMENT

W. C. Alexander, R. J. Sever, and F. G. Hoppin (Naval Air Develop. Center) [1964] 25 p refs Presented at the Aerospace Medical Assoc., Miami, Fla., 11 May 1964

(NASA-TM-X-51649) CFSTI: HC $1.00/MF $0.50 CSCL 06S

An investigation was undertaken to study the patterns and severity of hypoxia induced by prolonged forward acceleration while breathing pure oxygen at a pressure of one-third atmosphere under conditions that simulate the dynamic and environmental aspects of manned earth entry missions. Cabin environments of one atmosphere and one-third atmospheres, with air and 100% oxygen, respectively, breathed on demand by the pilot were employed in the study. Data collected for thirty-five professional military pilots demonstrate a resultant diminishing arterial oxygen saturation as a function of magnitude and duration of acceleration and the environment of the pilot. R.N.A.

N65-35317*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ELECTRON MICROSCOPY OF RAT CEREBELLAR CORTEX FOLLOWING EXPOSURE TO IONIZING RADIATION

Rosita F. de Estable, Juan F. Estable-Puig, and Webb Haymaker [1964] 26 p refs

(NASA-TM-X-51592) CFSTI: HC $2.00/MF $0.50 CSCL 06R

The purpose of this paper is to describe the ultrastructural changes found in the irradiated cerebellar cortex of the rat following fixation by osmium perfusion. The cerebellum was selected for study because it contains a wide variety of easily recognized cellular types and structures in a small volume of tissue. Author

N65-35520*# National Aeronautics and Space Administration, Washington, D. C.

BALLISTOCARDIOGRAPHY, A BIBLIOGRAPHY [1877–1964]

Sep. 1965 49 p Prepared jointly with FAA

(NASA-SP-7021; FAA-AM-65-15) GPO: $0.35/CFSTI: MF $0.50 CSCL 06E

N65-35524*# National Aeronautics and Space Administration, Washington, D. C.

THE PROBLEM OF ESTABLISHING TOLERABLE DOSES OF IONIZING RADIATION FOR CREW MEMBERS OF SPACECRAFTS

Yu. G. Grigor'yev, A. K. Gus'kova, M. P. Domshlak, V. G. Vysotskiy, S. A. Rayevskaya et al Oct. 1965 25 p refs Transl. into ENGLISH of the paper "Problema Obosnovaniya Dopustimykh Doz Ioniziruyushchey Radiatsii Dlya Chlenov Ekipazha Kosmicheskikh Korabley" USSR, Min. of Health Presented at 16th Intern. Astronautical Congr., Athens, 13–18 Sep. 1965

(NASA-TT-F-9589) CFSTI: HC $1.00/MF $0.50 CSCL 06R

A classification of irradiation levels was devised that can be used to evaluate cosmic radiation danger to spaceship crews during space flights. The categories set up and discussed are 1) the tolerable dose (TD), 2) the dosage of justifiable risk (JRD), and 3) the critical dose. Hospital patients who had been subjected to irradiation for treatment of cancer were studied for total body condition, and dynamics of peripheral blood changes. Varying degrees of reaction were studied, and a table giving the observational results in degrees of severity of primary reaction symptoms depending on radiation dosage is presented. The data indicate that most of the individuals tolerated 25 and 50 r radiation doses well. With increasing dosage the total number of individuals without primary reaction to irradiation was observed to decrease. With a 125 r dose, only 35.8% of the examinees were without clinical symptoms of total reaction. It was determined that the critical radiation dose during short space flights is 125 r. A tentative estimate of 100 rem/year is made for long flights. L.S.

N65-35526# California Univ., Livermore. Lawrence Radiation Lab.

PALMITYL-COENZYME A INHIBITION OF THE CITRATE-CONDENSING ENZYME

Paul A. Srere 22 May 1964 14 p refs

(Contract W-7405-ENG-48)

(UCRL-7896)

The citrate-condensing enzyme can be partially protected from palmityl-CoA inhibition by oxaloacetate. The interaction between the enzyme and palmityl-CoA led to the firm binding of 16 moles of the compound per mole of enzyme for a 27% inhibited enzyme. With a 70% inhibited enzyme little change was seen in the sedimentation behavior. It is concluded that the interaction is not physiologically significant. Author

N65-35580*# Stanford Research Inst., Menlo Park, Calif.

STUDIES ON THE HILL REACTION ACTIVITY OF SOLUBLE CHLOROPLAST EXTRACTS Final Report

Lloyd K. Moss and Janice E. Coomber 25 Aug. 1965 52 p refs

(Contract NASr 49-11; SRI Proj. BU-4435)

(NASA-CR-67374) CFSTI: HC $3.00/MF $0.50 CSCL 06C

Carrier-free continuous electrophoresis was applied to chloroplast fragments from common spinach, *Spinacia oleracea*, and the electrophoretic fractions tested as biochemical catalysts in the Hill reaction. Specific Hill reaction activity was successfully demonstrated after excursion through a commercial preparative electrophoresis instrument. Activity was greater for electrophoretic effluents than for unfractionated material. Maximum activity in the effluents did not correspond to the maximum chlorophyll concentrations, indicating either inhibition by certain components or some optimum proportion of catalytic cofactors. Differences in absorption spectra of fractions occurred in the ultraviolet region but were not significant in the visible region. Novel methods to preserve the

biological integrity of components were also studied. Although digitonin facilitated the solubilization of the pigment-protein complex, some Hill reaction activity was lost. DMSO (dimethyl sulfoxide) was a useful solubilizing agent with no detrimental effect on Hill activity. Preservation of activity was obtained by adding colloids, as normal and immune rabbit serum, gelatin, and dextran, to the solvent for chloroplast preparation. Further studies of proteins in fractions separated electrophoretically or by chromatography on Sephadex or modified cellulose ion exchangers are recommended. S.C.W.

N65-35630# Kent State Univ., Ohio.
SOME HISTOCHEMICAL RESPONSES OF GUINEA PIG TISSUES TO COLD
Charles G. Wilber Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Feb. 1965 16 p refs
(Contract AF 41(609)-1973)
(AAL-TDR-64-9; AD-615011)

Guinea pigs weighing approximately 300 gm were kept in a cold room, held at 6° C, for two weeks. Various organs were then studied histochemically. Liver glycogen is rapidly used up in cold-exposed guinea pigs. The fate of liver lipids is unknown. Lipids in the cortex of the adrenals appear to decrease, and chromaffin material in the medullary areas of the adrenals disappears. There is cavitation in the cortex and an erosion of medullary areas. There is increased metachromasia in the lower tubular areas of the kidneys, but the functional significance of this is not clear. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-34752 Joint Publications Research Service, Washington, D. C.
VARIATION PRINCIPLES IN THE BEHAVIOR OF LIVE ORGANISMS
G. A. Golitsyn *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 285–291 refs (See N65-34725 23-34) CFSTI: $6.00

A special case of the behavior of a fully trained living organism in a complex situation with several different goals, is investigated. It is shown that in this case its behavior must be subject to three basic principles: the Anoxin exclusion law, the Ukhtomskiy dominant principle, and the principle of least displeasure. Author

N65-35060*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FIXED-BASE-SIMULATOR STUDY OF ABILITY OF PILOTS TO PERFORM SOFT LUNAR LANDINGS BY USING A SIMPLIFIED GUIDANCE TECHNIQUE
G. Kimball Miller, Jr. and Herman S. Fletcher Washington, NASA, Oct. 1965 28 p refs
(NASA-TN-D-2993) CFSTI: HC $2.00/MF $0.50 CSCL 05H

A six-degree-of-freedom fixed-base-simulator study has been conducted of the ability of pilots to perform soft lunar landings by using a simplified guidance technique to deorbit from a synchronous transfer orbit and to place the landing vehicle in a position from which a vertical descent to touchdown in a specified area can be accomplished. The pilot had control of vehicle thrust along the longitudinal axis and of attitude through an acceleration command system. No automatic damping or control was assumed. The general piloting procedure consisted of maintaining a constant thrust angle with respect to the orbiting command module until nearly zero velocity was attained at an altitude of approximately 5000 ft. A vertical descent was then made to the lunar surface. Initially, a nominal trajectory was flown for which the deorbiting procedure was specified; subsequently, several off-nominal trajectories were flown. The results of the investigation indicated that the pilot's use of the simplified guidance technique with rather crude thrust-angle measurements resulted in placing the vehicle in a position from which soft landings in the desired lunar area could consistently be made. The characteristic velocity required for piloted landings was within about 10 percent of that required for a perfectly flown nominal trajectory. Author

N65-35197# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
COMPUTER SIMULATION OF VISUAL DATA PROCESSING IN THE HUMAN BRAIN
Donald La Marr Ockerman (M.S. Thesis) Jun. 1965 121 p refs
(GGC/EE/65-10; AD-619394)

The operation of the visual portion of the human brain has been simulated on the IBM-1620 and IBM-7094 digital computers. The simulation is designed using the cross-correlation method postulated by Dr. Kabrisky. The simulation is very coarse as the grain size of the visual area of the human brain is four hundred times finer than the computer model. The model stores new patterns, standardizes pattern sizes, rotates the input pattern and recognizes identical or similar patterns. The model is evaluated by inserting twenty test patterns. The model did seem to simulate the human visual recognition system for these input patterns. The model will recognize patterns that are reduced, enlarged, shifted, or rotated. After analyzing the satisfactory results recommendations are made for the design of larger and more intricate models. The computer programs and sample results are included. Author

N65-35199# Naval School of Aviation Medicine, Pensacola, Fla.
PERFORMANCE IN THE PRE-FLIGHT WATER SURVIVAL COURSE AS A PREDICTOR OF SUCCESS IN FLIGHT TRAINING
Charles W. Hutchins, Jr. and Richard S. Pomarolli Jun. 1965 11 p ref *Its* Spec. Rept.-65-3
(AD-619302)

The water survival course grades of 1300 Pre-Flight students were analyzed to determine the utility of these grades as predictors of eventual completion or failure in the flight training program. The Wherry-Doolittle method of test selection was used to evaluate two performance measures from the course: Mid-Course grade and the Swim-Hold status. Results indicate that both these measures make small but statistically significant contributions to the validity of the multiple predictor. There is evidence that the value of the water survival course as a predictor derives more from a student's initial ability as a swimmer than from his progress in the course. Author

N65-35219*# Massachusetts Inst. of Tech., Cambridge. Center for Communication Sciences.
A MODEL OF THE PERIPHERAL AUDITORY SYSTEM—A CASE STUDY IN NEURAL MODELING

Thomas F. Weiss [1964] 10 p Presented at the Intern. Bio- (Grants NsG-496; NSF GP-2495; NIH-NH-04737-04; Contract DA-36-039-AMC-03200(E))
(NASA-CR-58094) CFSTI: HC $1.00/MF $0.50 CSCL 05H

A method to formalize and test a mechanistic model of the peripheral auditory system is discussed. The spontaneous activity, response to acoustic clicks, tones and tone bursts were studied for a class of mechanistic models that consist of a linear mechanical system, a nonlinear, memoryless transducer and a model neuron. Results generated by this model fit the VIIIth cranial nerve data quantitatively along some dimensions and only in a very qualitative sense along other dimensions. R.W.H.

N65-35295# Naval Medical Research Lab., New London, Conn.
AUTONOMIC RESILIENCY, SUBJECTIVE SYMPTOMATOLOGY, AND SUBMARINE STRESS
Benjamin B. Weybrew 12 Nov. 1963 20 p refs
(MR-63-13; AD-465219)

Four difficulties encountered in research on biological stress are discussed and the major factors which may account for individual differences in stress adjustments are indicated. Also, the factors acting as stressors in the submarine environment are identified and the response pattern to these stress factors is delineated. The autonomic nervous system mechanisms concerned are described and stress methodology is presented. This investigation should provide better understanding of the stress factors inherent in prolonged submergence in a submarine and clues as to prophylactic measures which may prevent debilitative or pathological responses to prolonged stress. E.E.B.

N65-35296# Electro-Voice, Inc., Buchanan, Mich. Engineering Dept.
[AN EVALUATION OF THE EXPERIMENTAL HEADSET IN A HIGH INTENSITY NOISE FIELD] Status Report, 15 Feb. 1965–15 Mar. 1965
Robert C. Ramsey [1965] 4 p
(Contract AF 33(615)-1295)
(AD-463731)

An evaluation of an experimental headset in a high intensity noise field is briefly described. Listening and speaking tests were performed with the overall noise level adjusted to 114, 120, 126, and 129 db re .0002 dynes/cm^2 and with a spectrum shaped to the Gemini specification. Using the same high intensity noise facility a comparison between an experimental microphone and the M-93 microphone was performed. Results indicate that the loudness of the background noise was lower on the M-93 microphone for all test conditions; the difference in performance between the two microphones was least for the 1/2 inch position; and at high sound pressure levels the movement of the mouth near the M-93 caused an output signal such that an acoustic image effect was noted. G.A.L.

N65-35343# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.
ENGINEERING PSYCHOLOGY, TRAINING PSYCHOLOGY, ENVIRONMENTAL STRESS, SIMULATION TECHNIQUES, AND PHYSICAL ANTHROPOLOGY 1964 Supplement to a Bibliography of Reports Issued by the Behavioral Sciences Lab.
Lavon E. Trygg, comp. 1 Jan. 1965 14 p refs
(AD-464531)

A bibliography is presented on *Systems Development; Physical Anthropology; Apparatus; Control Design and Arrangement; Environmental Stress; Human Engineering; Maintenance; Methodology and Statistics; Personnel and Manning Requirements; Presentation of Information; Simulation; Tracking and Servo Analysis; Training and Learning;* and *Zero-G Studies.* E.E.B.

N65-35409*# SPACO, Inc., Huntsville, Ala. Human Factors Lab.
ON CERTAIN AREAS OF HUMAN FACTORS A Literature Search
Charles Edward White Aug. 1964 46 p refs
(Contract NAS8-11675)
(NASA-CR-67336) CFSTI: HC $2.00/MF $0.50 CSCL 05E

An annotated bibliography is presented on human factors and includes references on man's basic characteristics, man's characteristics at an interface, man's characteristics in a group, optimization of machine characteristics to match man's characteristics, optimization of environment to match man, extracted output from man, unusual input to man, handbooks on human factors and engineering, and bibliographies. The appendices contain abstracts of works on the brain machinery, biotechnology, and color vision theory. R.N.A.

N65-35430# Human Sciences Research, Inc., McLean, Va.
RESEARCH ON VISUAL TARGET DETECTION. PART 1: DEVELOPMENT OF AN AIR-TO-GROUND DETECTION/IDENTIFICATION MODEL
Margaret E. Franklin and John A. Whittenburg Jun. 1965 166 p refs
(Contract DA-31-124-ARO(D)-287)
(HSR-RR-65/4-Dt; AD-619275)

The objective was to develop a simple, operational model for predicting air-to-ground visual detection/identification of tactical targets. The model, based on data from the literature, was limited to conditions of daylight and clear visibility. A preliminary model was developed using data from a field study of air-to-ground detection-identification of tactical targets. Variables to be included in the model were selected from a list of variables found to be important in previous studies. The model includes estimates of eight input variables—target size, target shape, target/ground contrast, clutter, terrain type, aircraft altitude, aircraft speed, and range—which were grouped into three composite variables (target apparent size, target distinctiveness, and effective exposure time). A numerical summary of relevant studies on target detection/identification and a description of model calculations are presented as appendices. Author

N65-35517*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REMOTE PILOT-CONTROLLED DOCKING WITH TELEVISION
Edward R. Long, Jr., Jack E. Pennington, and Perry L. Deal Washington, NASA, Oct. 1965 35 p refs
(NASA-TN-D-3044) CFSTI: HC $2.00/MF $0.50 CSCL 05H

An investigation of the use of closed circuit television (CCTV) as an instrument for pilot-controlled visual docking of two space vehicles was conducted on the rendezvous docking simulator (RDS). The RDS is a full-scale dynamic facility which is used to study pilot-controlled docking of various types of space vehicles. The vehicles simulated in this study were the Gemini spacecraft and the Agena booster. The first part of this two-part study was designed to compare the pilot's ability to

remotely control a docking by using only information obtained from a television monitor with his ability to control the docking by direct vision from within the spacecraft. In the second part of the study the camera was mounted in the Gemini nose with the lens center line along the longitudinal axis of the vehicle, so that the camera saw no part of the Gemini vehicle. Author

N65-35542# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
KINETIC CUEING IN SIMULATED CARRIER APPROACHES. SUPPLEMENT I: STUDY DETAILS
Joseph N. Ruocco, Patrick A. Vitale, and Robert C. Benfari Port Washington, N. Y., U. S. Naval Training Device Center, 28 Apr. 1965 225 p
(Contract N61339-1432)
(NAVTRADEVCEN-1432-1-S1; AD-618756)

Pairs of matched pilots were trained using a flight simulator in a carrier-landing maneuver under two conditions, kinetic and static. This is a supplement for the technical reader providing detailed information on the equipment used, on the experimental design, and on the reduction of data. Author

N65-35574# Bureau of Social Science Research, Inc., Washington, D. C.
FEAR AND ENTHUSIASM IN SPORT PARACHUTING
Samuel Z. Klausner May 1965 34 p Submitted for Publication
(Contract AF 49(638)-992)
(AFOSR-65-1329; AD-619389)

Replies to a mail questionnaire by 825 sport parachutists affiliated with 103 parachute clubs are the data of this study. Questionnaires, administered by officials of the individual clubs, asked about the experience of fear and enthusiasm, personal and social characteristics of the parachutists, attitudes relevant to sport parachuting, and included the Ma and Hy scales from the MMPI, a draw-a-person test, and four story-stimulus pictures of parachuting situations. Only the jump experience, an analysis of the stories told about one picture, and a few social characteristics are reported. TAB

N65-35577*# RAND Corp., Santa Monica, Calif.
THE MONITORING TASK IN AUTOMATED CHECKOUT OF SPACE VEHICLES
L. Chesler and R. Turn Sep. 1965 52 p refs
(Contract NASr-21(08))
(NASA-CR-67371; RM-4678-NASA) CFSTI: HC $3.00/MF $0.50 CSCL 05H

The roles that a human monitor may need to assume in automated checkout operations are presented, the information requirements for performance of selected monitoring tasks is described, and a set of computer-driven information displays for increasing human effectiveness is proposed. Also, questions concerning implementation of the proposed displays are considered. It is suggested that providing the human monitor with means to regulate the rate of performance of automated testing may greatly increase the ability of humans to perform tasks. An outline for a network display program is included. E.E.B.

N65-35587# Graflex, Inc., Rochester, N. Y.
FILMSTRIP TECHNIQUES FOR INDIVIDUALIZED INSTRUCTION
William H. Trow and Edgar A. Smith (AMRL) Wright-Patterson AFB, Ohio, AMRL, May 1965 19 p refs
(Contract AF 33(657)-11339)
(AMRL-TR-65-78; AD-617609)

Factors affecting the selection of a film format as the visual medium in programmed instruction are discussed. Focused on are: revision, quantity, length, storage, recycling, the aspect ratio, change time, random access, and continuous repetition. Comparative cost data on the preparation of a master of the filmed program and duplicate copies are included; and problems associated with the preparation of filmstrips by staff photographers, such as single-frame cameras, the preparation of flat copy, exposure, and splicing, are discussed. Also described are several film formats applicable to audio-visual programming. S.C.W.

N65-35632# Air Force Systems Command, Wright-Patterson AFB, Ohio. Behavioral Sciences Lab.
TRAJECTORY VERSUS LINE-OF-SIGHT SPACE RENDEZVOUS USING OUT-OF-WINDOW VISUAL CUES Technical Report, Jun.–Sep. 1964
Herbert J. Clark Feb. 1965 64 p refs
(AMRL-TR-65-10; AD-615157)

Seven trained subjects flew simulated short range coplanar orbital rendezvous maneuvers, using direct visual cues only. Two rendezvous techniques were compared: line-of-sight and trajectory. In the former, the subject could control up-down and fore-aft thrust only; in the latter, he could, in addition, control pitch. Using either technique, all subjects were able to maneuver successfully to a position 100 ft directly in front of the target at a terminal velocity of less than 5 ft/sec. Significantly, less fuel was expended in performing the trajectory maneuver. The principal man-machine performance factors in the line-of-sight maneuver were tentatively described as (1) the ability to conserve fuel used for longitudinal and vertical translation, (2) the ability to conserve mission time, and (3) the ability to proficiently close with the target. Author

N65-35763# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Biophysics Lab.
A SUMMARY OF HUMAN TOLERANCE TO PROLONGED ACCELERATION Technical Report, Jan. 1963–Jan. 1965
Alvin S. Hyde and Harold W. Raab Feb. 1965 42 p refs
(AMRL-TR-65-36; AD-615570)

Human subject tolerance to accelerations of greater than one second duration is summarized for the X, Y, and Z axes. Because each investigator at each laboratory utilizes different restraint systems, body positions, ambient temperatures, etc, and most important, utilizes different criteria of "tolerance," the data are referenced and presented in tables and graphs for each major category (direction) of acceleration. The points presented in the graphs and tables are usually the highest values achieved; in each series there were subjects who could not tolerate the given direction, amplitude, and duration. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-34767# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 214

7 Sep. 1965 49 p refs Transl. into ENGLISH of 6 articles from K'O Hsueh T'ung Pao (Peking), no. 7, 20 Jul. 1965 p 634–648
(JPRS-31880; TT-65-32374) CFSTI: $2.00

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N65-34768 Joint Publications Research Service, Washington, D. C.

STUDIES OF PARAMAGNETIC RESONANCE OF ARYL ANIONS. VI: FLUORENE AND ITS 2-DERIVATIVE IONS

Chia-Lai Pan, Kuei-Hsiang Fu, and Kuang-Ying Li *In its* Transl. on Communist China's Sci. and Technol., No. 214 7 Sep. 1965 p 1–12 refs (See N65-34767 23-06) CFSTI: $2.00

The preparation of fluorene and its 2-derivative anions by reduction with alkali metals is described, and the spectra at room temperature is determined. In addition, cations were obtained by gamma-ray radiation in a boric acid glass bulb; although the spectra do not have hyperfine structures, they were found a useful aid in analyzing the spectra of anions. Tabulated data are given on the properties of the sample; the nuclear magnetic resonance spectrum of fluorene and its substitued compounds; and the spectra of fluorene and its substituted compound ions. Figures are included to show the paramagnetic resonance spectra of fluorene anion, 2-amino-fluorene anion, 2-acetylfluorene anion, fluorene cation, 2-nitrofluorene cation, 2-acetyl-fluorene cation, 2-bromo-fluorene cation, and 9-bromofluorene cation. Results from the spectrum analysis of fluorene ion indicate that the two protons from $> CH_2$ in the central five membered ring probably do not couple with the unpaired electron; the spectrum line distribution shows that the eight protons on the two benzene rings of fluorene couple into four pairs. M.G.J.

N65-34769 Joint Publications Research Service, Washington, D. C.

1,4 POLYMERIZATION OF BUTADIENE BY A SOLUBLE CATALYST NOT CONTAINING METAL ALKYL

Hung-Ch'uan Hsieh, Ping-Sheng Li, and Ying-Tai Chin *In its* Transl. on Communist China's Sci. and Technol., No. 214 7 Sep. 1965 p 13–21 refs (See N65-34767 23-06) CFSTI: $2.00

Experiments were conducted to show that the ether complex of $AlHCl_2$, the pyridine complex of $CoCl_2$, and $AlBr_3$ can form a three-component soluble catalyst for the 1,4 polymerization of butadiene. Polymerization was carried out under nitrogen, with monomer concentration, 100 g/liter; water control, 25 ppm; and polymerization time, three hours. Data are given on the effects of $AlHCl_2 \cdot Et_2O/CoCl_2 \cdot 4C_5H_5N$ mole ratio, and of $AlBr_3/AlHCl_2 \cdot Et_2O$ mole ratio on conversion and molecular weight of the product. Relationships are also shown between (1) the amount of $CoCl_2 \cdot 4C_5H_5N$ and conversion and molecular weight; (2) the polymerization temperature and conversion and molecular weight; and (3) H_2O content in the system and conversion and molecular weight. The effect of heptane used as the solvent on conversion and molecular weight, and the effect of N-phenyl-β-naphthylamine on polymerization are also discussed. Figures depict these findings. M.G.J.

N65-34771 Joint Publications Research Service, Washington, D. C.

COUNTER PHASE ANALYSIS—SEPARATION OF SELIUM, TELLURIUM, AND GOLD BY RING OVEN METHOD

Chang Kuang and Mu-Chuan Chang *In its* Transl. on Communist China's Sci. and Technol., No. 214 7 Sep. 1965 p 27–33 refs (See N65-34767 23-06) CFSTI: $2.00

Counter-phase paper chromatography was combined with the ring oven method to eliminate the adsorption of some separated ions at the surface of the precipitate. In the experiment, the ions were separated through the counter-phase analysis, and the separated ions were concentrated by the ring oven method. Filter paper treated with TBP–benzene solutions was used as the solid phase, and various concentrations of HCl, H_2SO_4, HNO_3, NaCl, and NHeCl were used as the eluting solvent to measure the movement behavior of selenium, tellurium, and gold. The effects of different TBP concentrations and different eluting solvents on separation are discussed, and the results of Au, Te, and Se separation under these various conditions are tabulated. Separation of the mixture, sensitivity of the analysis, the effect of coexisting elements (Cu, Bi, Pb, and As) on detection, and the effect of a large amount of Se on Te determination are also discussed. Results of the experimentation indicate that, by the choice of a suitable solvent, one test can separate and determine several coexisting elements. M.G.J.

N65-34837# California Univ., Riverside. Dept. of Chemistry.

ELECTROCHEMISTRY OF DISSOLVED GASES Final Report, 1 Mar. 1961–31 Mar. 1964

Donald T. Sawyer 1 Jan. 1965 37 p refs
(Contract AF 19(604)-8347)
(AFCRL-65-238; AD-467100)

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1. ELECTROCHEMICAL OXIDATION OF CARBON MONOXIDE AT GOLD ELECTRODES J. L. Roberts, Jr. and D. T. Sawyer 29 p (See N65-34838 23-06)

N65-34838 California Univ., Riverside. Dept. of Chemistry.

ELECTROCHEMICAL OXIDATION OF CARBON MONOXIDE AT GOLD ELECTRODES

Julian L. Roberts, Jr. and Donald T. Sawyer *In its* Electrochem. of Dissolved Gases 1 Jan. 1965 29 p (See N65-34837 23-06)

The electrochemical oxidation of carbon monoxide at gold electrodes in alkaline solutions has been studied by chronopotentiometric and galvanostatic methods. The rate of the oxidation has been found to be first order in CO concentration

and first order in hydroxide ion concentration, indicating that the two species rapidly form an electroactive species. The electrolysis, which gives carbonate ion as a final product, is totally irreversible. The kinetic parameters have been evaluated for a wide range of solution conditions; for an activated gold electrode the mean value for $(1-\alpha)n_a$ is 0.50 ± 0.02 and the mean value for the simple heterogeneous rate constant, $k_{s,h}$, is 3×10^{-9} cm. liter/mole sec. Mechanisms, which are consistent with the experimental data, are proposed; these include a one-electron rate controlling step leading to a radical intermediate. Author

N65-34851# General Precision, Inc., Little Falls, N. J. Aerospace Research Center.
HIGH-TEMPERATURE-RESISTANT PHTHALOCYANINE POLYMERS Quarterly Progress Report, 1 May–31 Jul. 1965
Daniel Grafstein et al 12 Aug. 1965 40 p refs
(Contract NObs-92081)
(QPR-3; AD-619372)

Most of the effort during the past quarter was directed toward the further development of bis(oxymethyl)carborane-siloxyphthalocyanine copolymer systems. $PcSi(SCN)_2$ was prepared from $PcSiCl_2$ and silver thiocyanate. Two polymeric materials were isolated when equimolar amounts of $PcSi(OH)_2$ and bis(hydroxymethyl)carborane were heated at 400° C under nitrogen. One was soluble in alcohol and pyridine; the other is insoluble in all solvents. It was determined that excess bis(hydroxymethyl)carborane was required to drive the sulfuric acid solution condensation reaction with $PcSiCl_2$ to completion. $PcSi(SCN)_2$ and bis(hydroxymethyl)carborane reacted at 200° C to give a number of different condensation products. One appeared to be a 1:1 condensation product, a second a 2:1 condensation product, and a third a 3:2 condensation product similar to the 3:2 condensation product previously isolated from $PcSi(NCO)_2$ and bis(hydroxymethyl)carborane and appears to be a dicarboranyl ether bonded to a siloxy phthalocyanine. The 3:2 product polymerized by dehydration when heated to 400° C in nitrogen. Boric oxide was the main product in air at 400° C. Butenylcarborane polymerized when it was maintained at reflux for 24 hours in nitrogen. This appears to occur by addition of the carborane B-H across the double bond. Author

N65-34863# Frankford Arsenal, Philadelphia, Pa.
DETERMINATION OF ZIRCONIUM METAL AND ZIRCONIUM POWDER
George Norwitz Jul. 1965 23 p refs
(T65-9-1; AD-619244)

An accurate method is proposed for the determination of zirconium in zirconium metal and zirconium powder. The sample is dissolved in a mixture of hydrofluoric, nitric, perchloric, and sulfuric acids, the solution is evaporated to dryness, the salts are dissolved in dilute hydrochloric acid, mandelic acid is added, the solution is heated at 80° C. for 40 minutes, the zirconium mandelate is filtered off, the residual zirconium in the filtrate is recovered by heating at 80° C. overnight, and the combined precipitates are ignited over a blast burner to zirconium dioxide. An investigation was made of the factors involved in the dissolution of the sample, precipitation with mandelic acid, ignition of the precipitate, and size of the sample. The effect of hafnium and possible interferences was considered. Author

N65-34864# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING FLUORINE AND CHLORINE IN POLYMERS BY THE GAMMA-ACTIVATING METHOD
L. V. Chepel' and F. V. Shemarov 29 Jul. 1965 63 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 158, no. 3, 1964 p 682–684
(FTD-TT-65-539/1+4; AD-619322)

An activation analysis of fluorine in organic compounds by F^{19} and F^{20} reactions is described. Measurements of activity of the samples were made on an installation, registering gamma-quanta, and originating during the annihilation of positrons. For simultaneous determination of fluorine and chlorine in one sample, a special analytical method was developed by measuring a given activity. Values were determined experimentally by a preselected time program of measurements of the given activity of a sample. It was noted that an analogous method was used for the combined determination of C, F, Cl, and a series of other elements. R.W.H.

N65-34876# Oak Ridge National Lab., Tenn. Isotopes Div.
REVIEW OF ISOTOPES TARGET PROGRAM, OCTOBER 1963–DECEMBER 1964
E. H. Kobisk Sep. 1965 42 p refs
(Contract W-7405-ENG-26)
(ORNL-3829) CFSTI: $2.00

The preparation of high purity isotopic metals and compounds, the preparation of Pu^{239}-coated fission chambers, and the development of radioisotope target preparation techniques are given. It is reported that impurity levels of isotopic materials were reduced and target quality enhanced by the improvement of ultrahigh vacuum systems, the use of electron bombardment evaporation and simultaneous reduction–distillation of metals. Ultrahigh vacuum systems were improved by the use of combined titanium sublimation and ion pumping. Electron-bombardment heating systems were improved for vacuum evaporation of isotopic materials, especially refractory metals and oxides at temperatures between 1500° and 3000° C. Simultaneous reduction–distillation techniques were developed to obtain rare earth metals of high chemical purity which could be rolled into foils with a thickness of ~50 μin. Special stable isotope targets of germanium and gallium oxide were prepared with film thicknesses of 500 $\mu g/cm^2$ and 50 to 200 $\mu g/cm^2$, respectively. C.T.C.

N65-34884# Barcelona Univ. (Spain). Dept. of Organic Chemistry.
SYNTHESIS AND PROPERTIES OF ALKAROMATIC CHLOROCARBONS Final Report
Manual Ballester 30 Nov. 1964 21 p refs
(Contract AF 61(052)-749)
(ARL-65-161; AD-618042)

The synthesis of 24 new chlorinated derivatives of diphenylmethane, fluorene, biphenyl, 1,1-diphenylethane, 1,1-diphenylethylene, acenaphthene, acenaphthylene, triphenylmethane and triptycene is reported. Among them there are 10 chlorocarbons, including 2 anions, 1 cation and 2 free radicals. The most outstanding result is the chemical inertness of the chlorocarbon free radicals (perchlorodiphenyl methyl, or PDM, and perchlorotriphenylmethyl, or PTM). Author

N65-34892# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL STABILITY OF LITHIUM BOROHYDRIDE
Ye. M. Fedneva, V. I. Alpatova, and V. I. Mikheyeva 5 Aug. 1965 8 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 9, no. 6, 1964 p 1519–1520
(FTD-TT-65-591/1+2+4; AD-619331)

Results are given of a study into the behavior of lithium borohydride and its dioxanate up to 600 degrees. Lithium

borohydride on heating liberated about 80% of its whole amount of hydrogen; the residue was a light-brown mass that gave off hydrogen under the action of H_2O. The dioxanate of the borohydride, $LiBH_4 \cdot C_4H_8O_2$, lost a molecule of dixane at 85 degrees with simultaneous liberation of hydrogen. The liberation of hydrogen became more intense above 400 degrees.
TAB

N65-34916# Nuklearni Institut Jozef Stefan, Ljubljana, (Yugoslavia).
SEPARATION OF Tc(YII) FROM IRRADIATED MoO_3 SAMPLE BY SOLVENT EXTRACTION WITH TRI-ISO-OCTYLAMINE
C. Klofutar, V. Stular, and F. Krasovec May 1965 9 p refs (NIJS-R-450) CFSTI: HC $1.00/MF $0.50

A solvent extraction method for the separation of technetium and molybdenum is outlined. After irradiation of MoO_3 and dissolution in sodium hydroxide, the shortlived Tc^{99m} isotope is extracted from 1 M HCl into solution of TIOA in 1,2-dichloroethane. The percentage of Mo^{99} in organic phase is less than 0.5%.
Author

N65-34966* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOME ASPECTS OF QUANTITATIVE ANALYSIS OF ROCKS BY X-RAY DIFFRACTION
Robert C. Speed *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 157–169 refs (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The fundamental petrologic data from which the origin of a rock may be interpreted are the composition, relative abundance, ordering, and geometry of phases in the assemblage. The geometric relations cannot be determined by X-ray diffraction. The ability of the method to provide the other data depends on three factors: instrumentation and operational parameters, specimen preparation, and mineral assemblage. These factors are discussed. Also, minimum detection limits, phase identification and description, and mineral abundances are considered for rock analysis with assumed conditions of high X-ray flux, electronic stability, and optimum specimen preparation. Data are presented which show that iron-bearing phases will greatly affect peak heights in mixtures by strong absorption of copper radiation. Consequently, it is important to assess the total Fe content of the specimen. This can be estimated from the iron fluorescence compounds in the background as measured by background intensities at several pulse-height analyzer baseline settings in relation to the copper distribution and low-energy counter noise.
E.E.B.

N65-34967* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DETERMINATION OF ABUNDANCE OF GLASS IN ROCKS BY X-RAY DIFFRACTION
D. B. Nash *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 171–175 refs (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The relative concentration of glass-crystal mixture, which can be determined by X-ray diffraction, is discussed. The intensity of the glass maximum is a function of four factors: (1) the concentration of the glass in the rock; (2) the glass composition; (3) the mass absorption coefficients of the glass and crystalline matrix; and (4) the instrument parameters. The minimum detectable limits for a glass phase in a crystal matrix is about 15 to 30 vol % for hypocrystalline rock mixtures. Variations are a function of composition. For silicate glasses, the higher the silica concentration the stronger is the diffraction maximum and the lower is the minimum detectable limit. Superposition of strong crystalline diffraction peaks upon the glass maximum make it difficult to distinguish the presence of glass in abundance less than 15 to 30 vol %. However, this is a function of the resolution of the diffractometer and may be improved by special geometry.
E.E.B.

N65-34968* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STUDIES OF THE ROCK-FORMING OXIDES BY X-RAY DIFFRACTION
R. C. Speed *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 177–190 refs (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

Preliminary results of studies to show quantatively the detection levels and the degree to which compositions can be determined in the oxide group by X-ray diffraction in rock analysis are presented. Thirteen of fifteen phases considered occur in the system $FeO–Fe_2O_3–MgO–Al_2O_3–CrO_2–TiO_2$. The chemical positions and names of the important minerals in this system are illustrated in octahedral space. The shift of (311), the strongest reflection, with composition in a spinel field where TiO_2 is absent is given. Also, the line shifts in the rhombohedral series of oxides are shown. The minimum detectable limits for the strongest reflection of each of the rock-forming oxides in different matrixes are tabulated. These matrixes were selected to represent both the most common rocks and the extremes of likely mass absorption coefficients. It was concluded that the average abundance of oxides in common rocks is considerably higher than the minimum-detectable limits of oxides for these rocks. The existence of an oxide series in a rock should thus be determinable by X-ray diffraction.
E.E.B.

N65-34969* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MINIMUM DETECTABLE LIMIT OF HEMATITE IN QUARTZ BY DIFFRACTION AND FLUORESCENCE
J. A. Dunne *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 191–192 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

A comparison between diffraction and fluorescence techniques for the determination of the quantity of the iron-bearing fraction in a two-phase mix is presented. The diffraction traces of the hematite (104) peak for 0.97, 0.46, 0.18, and 0.3 wt % hematite are shown. Fixed-time data indicated a 100-sec accumulation time minimum-detectable limit of 0.03 wt % hematite in quartz using the (104) peak. This is approximately four times the minimum detectable limit computed for the non-dispersive fluorescence analyzer. In a scanning mode, the data indicate a minimum detectable limit around 0.1 wt % Fe_2O_3. The relative contrast between the two methods is shown for comparison. This was obtained without using pulse-amplitude discrimination against the Fe fluorescence radiation. Where iron exists in a single phase, that phase can be determined with the best sensitivity by use of the fluorescence technique. For mixtures containing more than one iron-bearing phase, the minimum detectable limit for each phase will be that obtainable by diffraction.
E.E.B.

N65-34970* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
X-RAY DIFFRACTION ANALYSIS OF RADIATION DAMAGED ROCKS

D. B. Nash *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 193-202 refs (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

Samples of rock powder, single crystals, and iron-oxide powder were exposed to artificial proton beams of energy to 10 kev for durations of equivalent current to 10^6 year exposure to solar wind on the lunar surface. The samples were then examined by X-ray diffraction to detect changes during irradiation. The results indicated that moderate to radical changes can occur in both chemical and mineralogical composition of the samples as a result of the irradiation. The extent of the changes varied with the original composition of the material. Iron-oxide powder, basalt powder, greenstone powder, pumice, oliogoclase, and enstatite were investigated. On the assumption that the kind of radiation effects produced in these experiments occur on the moon, it was concluded that: (1) Anhydrous silicate phases on the lunar surface will be little affected by solar wind exposure for one million years. (2) X-ray samples of the lunar surface may be depleted in concentration by solar wind effects. (3) Iron oxide phases in surface exposed rock will be reduced to free iron. (4) Fresh bedrock will be unaffected by solar wind radiation. (5) X-ray diffraction analysis of rocks affected by proton bombardment cannot prove that the rock has been previously irradiated. E.E.B.

N65-34971* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

X-RAY DIFFRACTION IN PLANETARY EXPLORATION

G. Otalora *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 203-205 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The X-ray diffractometer is well suited to determine chemical identity of crystalline rocks, since each mineral component produces a characteristic diffraction pattern that is not altered by other minerals. By visual inspection or a programmed computer, it is possible to unscramble superposed patterns of crystal mixtures. It is also possible to measure relative abundance of minerals in a rock by comparing the intensity of selected reflected reflections from the phases present. Approximately 500 rocks were examined to compare the mineralogy of the specimens with their respective X-ray patterns and there was no great difficulty in the identification of the minerals present. Thus, X-ray diffraction techniques constitute the single most effective means for gathering data on the composition of the Moon and planets. E.E.B.

N65-34973*# Radiation Applications, Inc., Long Island City, N. Y.

WATER RECOVERY STUDY: ELECTROLYTIC PURIFICATION OF URINE Contractor Report, Jul. 7-Oct. 10, 1964

Alice Pucknat, Paul Scardaville, S. B. Tuwiner, and Thomas Wetherell 10 Nov. 1964 61 p

(Contract NASw-520)

(NASA-CR-67212; RAI-342) CFSTI: HC $3.00/MF $0.75 CSCL 07D

Design parameters of a urine electrolysis module for de-nitrifying of human urine are discussed from the standpoint of optimal current and energy efficiencies. Specifications for a module design that utilizes a centrifugal pump to circulate the urine through an electrolysis chamber, a reaction chamber, and a gas-liquid phase separator are evolved. The electrolysis will consume 2.767 kilowatt-hours per six liter batch of urine, and the required time for this process was estimated as 7.73 hours. Analyses of the gases evolved during electrolysis showed the anticipated CO_2/N_2 ratio for urea oxidation, and indicated that real urine undergoes electrolytic oxidation less efficiently than synthetic urine. A coliform bacteria assay of raw urine and the same urine after electrolysis showed both to be essentially free of coliform bacteria. G.G.

N65-34982# United Kingdom Atomic Energy Authority, Capenhurst (England). Production Group.

CHLORINE TRIFLUORIDE

L. M. Vincent and J. Gillardeau 1965 45 p refs Transl. into ENGLISH of Rept. No. 2360, Commissariat a l'Energie Atomique, France

(PG-IS-15(CA)) CFSTI: HC $2.00/MF $0.50

This monograph on chlorine trifluoride may be considered as a working tool useful in gaseous diffusion research. It consists of data gathered from the literature and includes furthermore a certain amount of original data. This monograph groups together the physical, chemical and physiological properties of chlorine trifluoride, as well as the preparation and analytical methods. It has been thought wise to add some technological information, and the safety regulations governing its use. Author

N65-34996# General Electric Co., Philadelphia, Pa. Missile and Space Div.

EFFECT OF CONTAMINANTS ON OBSERVABLES IN REENTRY Final Report

[1965] 127 p refs

(Contract DA-31-124-ARO(D)-214; ARPA Order 553)

(AD-470984)

The kinetics of the oxidation, the thermal excitation and deexcitation, and the chemiexcitation of sodium were studied in premixed laminar flames. Further evidence for the reaction

$$Na + O_2 + M \rightarrow NaO_2 + M$$

was obtained. The rate constants for the quenching of excited sodium by H_2O, O_2, and N_2 were determined by fluorescence quenching experiments. Evidence for sodium chemiexcitation was also obtained. The infrared spectra of sodium oxides were obtained using matrix isolation techniques. The results gave evidence for the existence of higher oxides of sodium. The role of excitation and deexcitation processes in the collisional ionization of sodium has been analyzed. The condition for which a step-wise process is important has been found. The oxidation of sodium was found to be important for conditions appropriate for wakes. Author

N65-35001# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

THE DISSOLUTION AND DIFFUSION OF OXYGEN IN ZIRCONIUM

W. W. Doerffler May 1965 29 p refs

(AECL-2268) CFSTI: HC $2.00/MF $0.50

Measurement of the diffusion coefficients of oxygen in *a*-zirconium by two methods have confirmed the results of Pemsler (for measurements of the dissolution rates of anodic oxides) and the results of Davis (by microhardness measurements on specimens from prolonged thermal oxidation). Repeated dissolution of anodic films and dissolution of thin thermal films gave higher values for the diffusion coefficient and suggested that this may be a function of the oxygen content. Oxidation in air gave anomalous microhardness curves showing a much longer 'tail' than expected from the rate of oxygen diffusion. This may be indicative of some interaction between oxygen and nitrogen, with nitrogen diffusing ahead of the oxygen gradient. In the absence of oxygen, the diffusion coefficient for nitrogen is much smaller than that for oxygen. Author

N65-35003# Gt. Brit. Ministry of Aviation, Nottingham. Technical Information and Library Services.
REACTIONS OF HYDROXYL WITH THE MOLECULES OF DIFFERENT GASES. II: REACTIONS OF FREE HYDROXYL WITH HYDROGEN AND CARBON MONOXIDE [REAKTSII GIDROKSILA S MOLEKULAMI RAZLICHNYKH GAZOV. II: REAKTSII SVOBODNOGO GIDROKSILA S VODORODOM I OKIS'YU UGLERODA]
L. I. Avramenko and R. V. Lorentso Aug. 1965 10 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 24, no. 2, 1950 p 207–213
(TIL/T-5548) CFSTI: HC $1.00/MF $0.50

Spectrographic measurements are used to deduce a general formula for calculating constants for the rate of fundamental hydroxyl reactions in order to determine the role of reactions of free hydroxyl with hydrogen and carbon monoxide. The hydroxyl was introduced into the reaction vessel by means of a jet of water vapor, and a volume increment of the reaction vessel was examined. Velocities are thus obtained, and an expression is determined for the rate of consumption of the hydroxyl with a molecule of the combustible. Concentration of the hydroxyl is described as a function of distance from the nozzle of the jet dispenser; and the general formula is evolved. Results of measurements relating to the constant for the rate of the reaction are in agreement with previous calculations; however, different values of pre-exponential coefficients and activities energies are found. M.W.R.

N65-35027# Los Alamos Scientific Lab., N. Mex.
HEAT CAPACITIES OF $NbC_{0.702}$, $NbC_{0.825}$, $NbC_{0.980}$ AND Nb_2C BELOW 320° K
T. A. Sandenaw and E. K. Storms 5 Aug. 1965 9 p refs
(Contract W-7405-ENG-36)
(LA-3331) CFSTI: $1.00

The heat capacities of $NbC_{0.702}$, $NbC_{0.825}$, $NbC_{0.980}$ and Nb_2C have been measured between 7.5° K and 320° K, using an adiabatic calorimeter. Calculated values for entropy and enthalpy have been tabulated as functions of composition and temperature. Author

N65-35028# Battelle Memorial Inst., Columbus, Ohio.
CHARACTERIZATION OF PYROLYTIC-CARBON FUEL-PARTICLE COATINGS PREPARED WITH ACETYLENE
Melvin F. Browning, Dale A. Vaughan, Joseph F. Dettore, and John M. Blocher, Jr. 19 Jul. 1965 44 p refs
(Contract W-7405-ENG-92)
(BMI-1735) CFSTI: $1.00

The structure and properties of fuel particle coatings prepared by thermal decomposition of actylene were studied as a function of preparation conditions. Comparisons were made with reference coatings prepared from methane, and with results obtained with methane in other laboratories. Three types of coatings were identified: (1) Dense laminar structures with a relatively high degree of anisotropy and a small crystallite size (2) low-density, relatively isotropic deposits with small crystallite size (3) dense granular (columnar) structures with a low degree of long-range anisotropy and a relatively large crystallite size. With minor exceptions, the boundaries between structures, though not distinct, appear to be shifted toward lower temperature in going from methane to acetylene. Author

N65-35030# Oak Ride National Lab., Tenn.
HOT-CELL DISSOLUTION OF HIGHLY IRRADIATED 20% PuO_2–80% UO_2 FAST-REACTOR FUEL SPECIMENS
J. H. Goode Oct. 1965 24 p refs
(Contract W-7405-ENG-26)
(ORNL-3754) CFSTI: $2.00

The fuel consisted of stainless-steel-clad PuO_2-UO_2 (20%–80%), swaged or pelletized, made and irradiated by General Electric's Vallecitos Atomic Laboratory. The irradiation levels were as high as 99,000 Mwd/metric ton. It was found that shearing the elements into short pieces and dissolving the core with nitric acid was preferable to chemical decladding with sulfuric acid solutions because of excessive (1.5%) losses of uranium and plutonium. Also, about 60% of the fission-product cesium dissolved in the sulfuric acid; the decay heat from this cesium could cause problems in waste management. More than 99% of the PuO_2-UO_2 dissolved in less than 5 hr in all concentrations of nitric acid greater than 3 *M*. No fluoride was needed to accelerate the reaction, which is a distinct advantage. Undissolved residues consisted of core oxides and fission-product Mo, Zr, Pd, Ru, and Rh. Feed clarification would be required to remove these solids prior to final recovery of the fissile material by solvent extraction. Author

N65-35032# Oak Ridge National Lab., Tenn.
TRANSURANIUM Quarterly Progress Report, Period Ending Nov. 30, 1964
W. D. Burch, comp. Sep. 1965 61 p refs
(Contract W-7405-ENG-26)
(ORNL-3847) CFSTI: $3.00

The nitric acid solubility of dry double-sulfate salts of americum, curium, and rare earths, as well as their sulfate contents removal was studied. The maximum solubility of $NaLa(SO_4)$ was 35.8 g of lanthanum per liter in 6 M HNO_3. Sodium and sulfate were effectively removed, and 246 g of PuO_2 containing 217 g of ^{242}Pu were prepared by precipitation method. Separation studies on trivalent actinides from lanthanides by extraction with di(2-ethylhexyl)phosphoric acid from solutions containing lactic acid and diethylenetriamine pentaacetic acid showed good separations of americum from various lanthanides. The design and installation of a curium facility was completed, and initial shakedown runs indicated a gross gamma decontamination factor of 150 for 33 liters of solution containing 4.09 g of ^{244}Cm and about 4 g of ^{243}Am. The conceptual designs of all pieces of equipment for the Transuranium Processing Plant were completed, as was 85 percent of the detailed design. A target rod, containing ^{242}Pu, achieved an estimated burnup of 80 at. percent. Corrosion tests of Zircaloy-2 in 8 *M* HCl at 35° to 105° C showed nominal corrosion, but severe hydrogen pickup. G.G

N65-35033# Atomics International, Canoga Park, Calif.
THE NATURE AND PROPERTIES OF THE CARBIDES OF URANIUM
O. O. Gamba 31 Aug. 1965 62 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10929)

This report is an evaluation of the literature on the technology of the carbides of uranium. It summarizes the information on their preparation and their physical and mechanical properties, and discusses their chemical behavior in environments related to their application as nuclear fuel. It also describes the fabrication of uranium carbide products, and the compatibility of these products with cladding materials. Author

N65-35041# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Space and Defense Sciences Dept.
DESIGN OF HYDROGN-OXYGEN CAPILLARY TYPE FUEL CELL Quarterly Technical Progress Report, 1 May–31 Jul. 1965

13 Aug. 1965 45 p
(Contract AF 33(615)-1185)
(QTPR-7; AD-619687)

Specifications issued during the reporting quarter included those for welding, plating and handling of the fuel cell plates, the purge cycle timer design specification and the fuel cell system qualification test specification. The design of the 1965 prototype module was completed and parts are being fabricated. Design of the 1965 deliverable modules is in progress. Operational testing and the preliminary motion test of the 1964 prototype modules were completed. Technical assistance was provided in coordinating interface conditions for the orbital flight. Both packages were operationally checked and performances were satisfactory. We are presently awaiting confirmation of the experimental flight schedule. Author

N65-35051# Nuklearni Institut Josef Stefan, Ljubljana (Yugoslavia).
PRELIMINARY MAGNETIC RESONANCE AND SUSCEPTIBILITY STUDY OF $UO_2 \cdot xH_2O$
M. Komac, M. Pintar, and D. Kolar May 1965 5 p refs
(NIJS-R-452) CFSTI: HC $1.00/MF $0.50

A magnetic resonance and susceptibility study of uranium oxide hydrate, $UO_2 \cdot xH_2O$ for $x = 1$ to $x = 2.37$, is summarized. Two methods for the preparation of the hydrous uranium oxide samples are given. The water content and uranium/oxide ratio of samples were determined in combined experiments using micro Pregel apparatus. The samples were ignited up to 900° C for two hours in a flow of purified dried oxygen. The water content was estimated from the weight change of absorption traps filled with magnesium perchlorate, and the initial uranium/oxide ratio was calculated from the U_3O_8 weight. The magnetic susceptibilities were measured with a Gouy balance and the results, presented in tabulated form, indicate that the susceptibility decreases as x increases. A Pound–Watkins regenerative oscillator operating at 41 Mc/s was used to study the proton magnetic resonance absorption of $UO_2 \cdot H_2O$. Experimental results give evidence that the compounds studied are mixtures of U^{+4} oxide hydrate $UO_2 \cdot xH_2O$ and U^{+4} hydroxide $U(OH)_4$ with small traces of U^{+6} oxide hydrate or hydroxide present. M.R.W.

N65-35080# Western Ontario Univ., London. Dept. of Chemistry.
THE PHOTOCHEMICAL PRODUCTION OF STRAINED RINGS Final Report
P. De Mayo 3 May 1965 8 p refs
(Grants AF-AFOSR-J1368; AF-AFOSR-99-63)
(AFOSR-65-0970; AD-617927)

The object of the research was the photochemical synthesis of rings. It was found that intermolecular cycloaddition, a previously unknown phenomenon outside dimerization, could be induced photochemically. While simple unsaturated ketones appeared unreactive, the hydrogen bonded cyclic ketone acetyl acetone could be induced to participate. Further, this diketone had the advantage that any hydrogen abstraction would give a diradical which would be immediately converted, by spin inversion, into the starting material. Two other unrelated photochemical studies are also reported: (1) the photosensitized oxidation of pyrrole, providing the structure of the product maleimide and the mechanism of oxidation; and (2) the dimerization of alpha-pyridones and sultones as a means of building cyclic systems. TAB

N65-35087# AMOCO Chemicals Corp., Seymour, Ind. Propellants Div.
TECHNICAL REPORT ON THE STUDY OF BORON PERCHLORATE AND RELATED SYSTEMS Final Report, Oct. 1, 1964–Sep. 30, 1964
[1964] 29 p refs
(Contract AF 49(638)-1105)
(AFOSR-65-1055; AD-617941)

The compounds BCl_2ClO_4, $BCl(ClO_4)_2$ and $B(ClO_4)_3$ have been prepared by the reaction between BCl_3 and anhydrous $HClO_4$. Density, refractive index, molecular weight and surface tension have been determined for the boron chloroperchlorates. Molar refractivity and the parachor were calculated for the chloroperchlorates and both give values which agree closely with values for the postulated compounds. Heat of hydrolysis was determined calorimetrically for BCl_2ClO_4 and from this, a value for the heat of formation was derived which agrees closely with a calculated value. An oxidation reaction occurs with PCl_3, and with XeF_4 a decomposition reaction takes place probably preceded by dehydration of the perchloric acid. Exchange reactions between BCl_2ClO_4 and BF_3 gave only partial replacement of Cl by F, and replacement of both perchlorate and halogen occurs with chlorine trifluoride. Author

N65-35088# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.
STUDY OF SUPEROXIDIZERS Final Report, 1 Dec. 1961–31 Jan. 1965
D. A. Csejka 12 Mar. 1965 40 p refs
(Contract AF 49(638)-1137)
(AFOSR-65-1050; AD-617964)

The reactions of hydrogen atoms with gaseous ozone and with oxygen were studied to determine if hydrogen superoxide (H_2O_4) could be obtained in higher yields. Hydrogen superoxide was examined by X-ray, nuclear magnetic resonance, and infrared methods at low temperature in order to determine its structural characteristics. The heat of decomposition and formation of H_2O_4 were determined at −196° C. The reactions of H_2O_4 with ammonia, chlorine, and ethylene were studied. Di-*t*-butyl tetroxide was prepared so that the O_4 species could be examined by infrared spectroscopic techniques. The reactions of ozone with hexafluoroethane, ammonia, bromine trifluoride, and chlorine trifluoride were studied. Tetrafluorohydrazine was treated with ozone, oxygen atoms, oxygen, and potassium superoxide in an effort to prepare new oxides such as NF_2ONF_2, NF_2OONF_2 and NF_2OOH. The preparation of chlorine tetroxide was investigated. Reactions of nitrogen trifluoride with ethane, ammonia and diborane at elevated temperatures were examined. Author

N65-35096# London Univ. (England). Birkbeck Coll.
STUDIES IN ION SOLVATION IN MIXED SOLVENTS Final Technical Report, Dec. 1, 1963–Nov. 30, 1964
D. Feakins [1964] 86 p refs
(Contract DA-91-591-EUC-3183)
(AD-465925)

We have examined transfers of electrolytes from water to methanol-water mixtures. The free energies of transfer, $\Delta G_t^\dagger$, of (i) H^+Cl^-, H^+Br^- and H^+I^- and (ii) Li^+Cl^-, Na^+Cl^-, K^+Cl^- were shown to be approximately linear in the reciprocals of (i) the anionic, r_a, and (ii) the cationic, r_c, radii respectively. Two independent, closely concordant sets of $\Delta G_t^\dagger$-values for single ions were obtained. In the mixtures, the secondary solvation tends to raise all the ionic free energies from their values in pure water. It was suggested that all molecules in

a methanol-water mixture are better electron-donors and poorer proton-donors than those in pure water. Thus, the primary solvation in these mixtures tends to raise further the anionic, but to lower the cationic free energies, the net ΔG_t^*-values being positive for anions and negative, and numerically smaller, for cations. Author

N65-35098# Oak Ridge National Lab., Tenn.
THE ISOTOPIC COMPOSITION OF ATMOSPHERIC NEON
J. R. Walton and A. E. Cameron Sep. 1965 17 p refs
(Contract W-7405-ENG-26)
(ORNL-3857)

"Absolute" values for the isotopic abundance ratios of atmospheric neon have been determined by mass spectrometry. Calibration standards were prepared by mixing of nearly pure separated nuclides of neon. The percentage abundance of the three nuclides of neon are:

$$^{20}Ne = 90.513_9 \pm 0.031;$$

$$^{21}Ne = 0.265_7 \pm 0.005;$$

$$^{22}Ne = 9.220_5 \pm 0.029;$$

The calculated atomic weight of neon on the unified physical and chemical atomic weight scale ($^{12}C = 12$) is 20.1794 ±0.0030. Author

N65-35127* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
PARTIAL MOLAR PROPERTIES OF MAGNESIUM BASE BINARY THERMAL ENERGY STORAGE SYSTEMS
Geoffrey Belton and Y. Rao *In its* [Res. in Mater., Plasma and Electrochem. Eng.] 1 Jul. 1965 12 p refs (See N65-35125 2334) CFSTI: HC $3.00/MF $0.75

The experimental emf vs T data for Mg_2Si and Mg_2Ge were shown. The linear dependence of emf upon temperature shows that the entropy was independent of temperature; the galvanic cells were represented. The emf vs T data permitted the calculation of the thermodynamic properties of the following reactions: 2 Mg (1) + Si(S) = Mg_2Si(S), and 2 Mg (1) + Ge(1) = Mg_2Ge(S). The free energy change, ΔF, of the cell reaction at any given temperature was related to the reversible electromotive force, E, by $\Delta F = -NFE$. Both Mg_2Si and Mg_2Ge have CaF_2 (C_1 type) structure. The lattice constants, melting points, and heats of formation for these and also for the compounds Mg_2Pb and Mg_2Sn were given in tabular form. It was noted that the higher the heat of formation, the higher was the melting point of the compound. R.W.H.

N65-35128* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
VOLUME CHANGE ON FUSION FOR CHLORIDES AND FLUORIDES
Ram A. Sharma *In its* [Res. in Mater., Plasma and Electrochem. Eng.] 1 Jul. 1965 7 p refs (See N65-35125 23-34) CFSTI: HC $3.00/MF $0.75

Presented in this investigation is a simple technique in which the volume change on fusion was obtained by measuring the volume of the cavity formed at the top of the sample during solidification and the volume of the solid obtained. The volume of the cavity was obtained from the weight of the mercury required to fill the cavity. The volume of the solid was also measured from the weight of mercury displaced by the solid. Densities of the samples were calculated from the weights of the samples and the volumes as a check on the possibility of void formation in the sample on solidification. R.W.H.

N65-35134# Joint Publications Research Service, Washington, D. C.
CHEMICAL ETCHING KINETICS OF MONOCRYSTALLINE GALLIUM ARSENIDE
28 Sep. 1965 16 p refs Transl. into ENGLISH from the book "KHIMIYA TVERDOGO TELA" Leningrad, Leningrad State Univ., 1965 p 218–230
(JPRS-32170; TT-65-32663) CFSTI: $1.00

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2. CHEMICAL ETCHING KINETICS OF MONOCRYSTALLINE GALLIUM ARSENIDE IN HYDROCHLORIC ACID SOLUTIONS OF HYDROGEN PEROXIDE G. M. Orlova, S. K. Yerofeyev, and N. V. Romanova p 10–13 refs (See N65-35136 23-06)

N65-35135 Joint Publications Research Service, Washington, D. C.
CHEMICAL ETCHING KINETICS OF MONOCRYSTALLINE GALLIUM ARSENIDE IN ALKALINE SOLUTIONS OF HYDROGEN PEROXIDE
G. M. Orlova, S. K. Yerofeyev, and N. V. Romanova *In its* Chem. Etching Kinet. of Monocrystalline Gallium Arsenide 28 Sep. 1965 p 1–9 refs (See N65-35134 23-06) CFSTI: $1.00

A discussion of the chemical etching kinetics of monocrystalline gallium arsenide in hydrochloric acid solutions of 0.7 N hydrogen peroxide is presented. Investigations show that the nature of the etching process differs substantially from dissolution in alkaline solutions of hydrogen peroxide and is appreciably determined by the acid concentration. In the hydrochloric acid concentration range of 0.12 to 1.93 N the process of chemical etching is limited by the rate of heterogeneous chemical reaction and does not depend on the hydrochloric acid concentration. In more dilute hydrochloric acid solutions formation of a film of amphoteric gallium hydroxide has a marked effect on the rate of dissolution of gallium arsenide. G.A.L.

N65-35136 Joint Publications Research Service, Washington, D. C.
CHEMICAL ETCHING KINETICS OF MONOCRYSTALLINE GALLIUM ARSENIDE IN HYDROCHLORIC ACID SOLUTIONS OF HYDROGEN PEROXIDE
G. M. Orlova, S. K. Yerofeyev, and N. V. Romanova *In its* Chem. Etching Kinet. of Monocrystalline Gallium Arsenide 28 Sep. 1965 p 10–13 refs (See N65-35134 23-06) CFSTI: $1.00

The kinetic regularities of the etching of monocrystalline gallium arsenide with alkaline solutions of hydrogen peroxide were investigated. Results indicate that in dilute alkaline solutions dissolution is limited by the diffusion rate, and with an increase in alkaline concentration the rate of dissolution is determined by the rate of chemical reaction. The maximum dissolution rate was observed in the region of 0.1 to 0.25 N NaOH. Increasing the hydrogen peroxide concentration in 0.25 to 1.0 N alkaline solutions led to a uniform rise in the dissolution rate of gallium arsenide. G.A.L.

N65-35144# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
NEW ORGANIC SILICATES: (3-PHENOXY-PHENOXY) SILANES

Jun. 1965 13 p Transl. into ENGLISH from French Patent No. 1,317,620, Addition 81,295
(RSIC-426; AD-619024)

Object of the invention is a production process for thermostable, organic silanes of formula $(RO)_nSiY_{(4-n)}$. These new products constitute means for the transmission of heat, a hydraulic fluid, or a lubricant. Author

N65-35149# Warsaw Univ. (Poland).
THE INFLUENCE OF LIGHT (405 mμ) AND γ-RADIATION ON THE REDUCTION AND OXIDATION OF U(VI) AND U(IV) IONS IN AQUEOUS SOLUTIONS [WPLYW PROMIENIOWANIA OPTYCZVEGO WYSOKO ENERGETYCZNEGO NA REAKCJE REDUKCJI I UTLENIANIA JONOW U(VI) I U(V) W ROZTWORACH WODNYCH]
Jerzy Sobkowski 1964 68 p refs In POLISH; ENGLISH summary
(NP-15054) CFSTI: HC $3.00/MF $0.75

The influence of light (405mμ) and γ-radiation on reduction and oxidation of U(VI) and U(IV) ions has been investigated. Under the influence of light U(VI) ions undergo reduction to U(V) ions, which disproportionate to U(IV) and U(VI). The course of reaction was indicated by the changes of potential of the platinum electrode, immersed in the solution containing U(IV) and U(VI). It was observed, that the photoelectrochemical effect increased in the presence of complexing agents. The rate constants and the energies of U(V) disproportionation were determined in perchloric acid and in solutions containing sulphates, citrates and tartrates. The oxidation of U(IV) ions by γ-radiation was investigated by the polarographic method. The yields of oxidation of U(IV) ions in relation to their concentration in the solution were determined. On the basis of the obtained experimental data, the mechanism of oxidation of U(IV) ions by γ-radiation was proposed. Author

N65-35157# Argonne National Lab., Ill.
LABORATORY INVESTIGATIONS IN SUPPORT OF FLUIDBED FLUORIDE VOLATILITY PROCESSES. PART VII: THE DECOMPOSITION OF GASEOUS PLUTONIUM HEXAFLUORIDE BY ALPHA RADIATION
Raymond P. Wagner, William A. Shinn, Jack Fischer, and Martin J. Steindler May 1965 33 p refs
(Contract W-31-109-ENG-38)
(ANL-7013) CFSTI: $2.00

Gaseous plutonium hexafluoride (PuF_6) decomposes at temperatures between 26 and 82° C to plutonium tetrafluoride (PuF_4) and fluorine, at least in part due to irradiation by alpha particles from the plutonium. The rate of decomposition is nonlinear, varying from 1.78 to 0.064% per day in the range from 0.5 to 571 days. Experiments with PuF_6 at initial pressures of 50 and 100 showed that at the lower pressure slightly lower decomposition rates are obtained. The presence of initial PuF_4 decreases the rate of decomposition, but this decrease in rate appears to be independent of the quantity of initial PuF_4. The presence of helium or krypton lowers the rate, but not appreciably. Oxygen or fluorine decreases the PuF_6 decomposition rate. Nitrogen reacts slowly with PuF_6 to form nitrogen trifluoride (NF_3). Increased nickel surface area gives increased PuF_6 decomposition rates in the absence of initial PuF_4. At 82° C the PuF_6 decomposition rate is higher than at 26° C. Author

N65-35162# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THERMAL EFFECTS IN ANION EXCHANGE RESIN-NITRIC ACID SYSTEMS
W. J. Van Slyke, G. Jansen, Jr., and W. H. Swift Aug. 1965 70 p refs
(Contract AT(45-1)-1830)
(BNWL-114) CFSTI: $3.00

A study is presented which defines unsafe operating conditions, specifies appropriate safety precautions, and clarifies the causes of some previous incidents by characterizing the heat and gas producing chemical effects for the anion resin–nitric acid system. An analysis of the instability conditions when operating with an anion exchange resin in 7M HNO_3 was made. The reaction kinetics for the system were investigated by externally heated pipe pressurization tests, and by calorimater experiments. The chemical and physical properties were correlated by mathematical models for batch and flow cases to predict the conditions that permit self-accelerating chemical reactions. It was found that uncontrolled reaction conditions are favored by: increasing vessel radius; low vessel wall heat transfer coefficients to the surroundings; low thermal conductivity of the vessel contents; high ambient and operating temperatures; and chromium (VI) loaded on the resin. The relations between these variables for the chemical system are graphically presented. C.T.C.

N65-35168*# Gulton Industries, Inc., Metuchen, N. J.
INVESTIGATION OF BATTERY ACTIVE NICKEL OXIDES Final Report
P. Ritterman and H. N. Seiger 11 Jun. 1965 92 p refs
(Contract NAS3-4178)
(NASA-CR-54654) CFSTI: HC $3.00/MF $0.75 CSCL 07D

A study of the compounds formed on a nickel oxide electrode with respect to charged stand, charge rate, state of charge, and during overcharge, has been made. This was done using X-ray diffraction, differential thermal analysis, chemical analysis, and spectrography. It was found that the active compounds of the electrode are essentially β NiOOH and $Ni(OH)_2$ during ordinary conditions of charge and discharge. During overcharge, an unstable compound is found having the X-ray patterns of γ NiOOH. These patterns were obtained by means of X-ray monitoring a two plate cell during overcharge. Data for decay of this compound during open circuit stand are also presented. Differential thermal analysis has indicated the existence of a compound of nickel at the "graphitic" level which differs from both β NiOOH and $Ni(OH)_2$. Initial cycling data and testing are also presented for sintered plate nickel and tubular graphite types of positive plates. An experiment for stabilizing the sintered plate nickel oxide electrode by means of formation at various rates and temperatures has been started. Author

N65-35195# Culver Military Academy, Ind.
COORDINATION STUDIES WITH POLYMERIC SILYL AMINES AND AMIDES Final Report
Ronn N. Minne' Aug. 1965 15 p refs
(Contract Nonr-3711(00))
(AD-619245)

It was found that the dimethylsilylamine polymer formed by reaction between dimethyldichlorosilane and ethylenediamine will react with anhydrous beryllium chloride to produce a coordination polymer which contains sufficient beryllium to coordinate up to 72% of the nitrogen atoms in the polymer, assuming that beryllium is four-coordinate. Reaction of the dimethylsilylamine polymer with aluminum chloride altered the physical properties of the polymer, but reaction with aluminum fluoride produced no change. The silylamine polymer formed by reaction between diphenyldichlorosilane and ethylenediamine has interesting adhesive properties and good resistance to hydrolysis. It shows only a slight tendancy to react

with beryllium chloride. A resinous polymeric amide was prepared by reaction between ethylenediamine and fumaric acid. Coordination attempts with this polymer were unsuccessful, but coordination studies with polymers containing double bonds merit further attention. Author

N65-35223*# California Univ., Berkeley. Space Sciences Lab
APPLICATION OF HIGH RESOLUTION MASS SPECTROMETRY IN MOLECULAR STRUCTURE STUDIES
A. L. Burlingame [1964] 27 p refs Presented at the Intern. Conf. on Mass Spectrometry, Paris, 14–18 Sep. 1964 Submitted for Publication
(Grant NsG-101-61)
(NASA-CR-56913) CFSTI: HC $1.00/MF $0.50 CSCL 07C

Automatic data reduction from high-resolution mass spectrograms, and elucidation of fragmentation mechanisms of *Amaryllidaceae* and *Lycopodium* alkalpids via accurate mass measurements of all major fragments in the high resolution mass spectrogram are discussed. The chief experimental problem involved in high resolution mass spectrography is the reduction of data from the photoplate. A digitized, high-precision automatic recording microphotometer was employed to give simultaneously line position (in microns) and plate blackening (in percent transmission). In connection with the determination of the structure of Amaryllisine, an *Amaryllidaceae* alkaloid, the mass spectra of several alkaloids in the crinine series were examined by low resolution mass spectrometry. From these conventional mass spectra of buphanisine and dihydrobuphanisine, it was noted that reduction of the 1,2-double bond altered the fragmentation pattern of the basal carbon skeleton. R.W.H.

N65-35242*# National Aeronautics and Space Administration, Washington, D. C.
THERMODYNAMICS AND APPLICATIONS OF BIOELECTROCHEMICAL ENERGY CONVERSION SYSTEMS
Michael G. Del Duca and John M. Fuscoe [1964] 60 p refs Presented at the 6th AGARD Combust. and Propulsion Colloq. on Energy Sources and Energy Conversion, Cannes, France, 16–20 Mar. 1964
(NASA-TM-X-51593) CFSTI: HC $3.00/MF $0.50 CSCL 06A

The state-of-the-art in biochemical energy conversion is reviewed and a synopsis of suggested applications ranging from the use of bioelectric currents for identification of toxic materials, the power supply for human implanted cardiac pace makers, to the generation of electric power in remote areas of the world. A number of potential bioelectrochemical oxidation-reduction couples are listed that indicate a feasibility as fuel electrodes with an oxygen cathode. G.G.

N65-35252*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VAPORIZATION OF TANTALUM CARBIDE–HAFNIUM CARBIDE SOLID SOLUTIONS AT 2500° TO 3000°K
D. L. Deadmore Washington, NASA, 1964 28 p refs Presented at the 66th Ann. Meeting of the Am. Ceramic Soc., Chicago, 18–23 Apr. 1964
(NASA-TM-X-52014) CFSTI: HC $2.00/MF $0.50 CSCL 07D

The vaporization rates in vacuum of hot-pressed HfC, TaC, and solid solutions of these two carbides in the temperature range of 2500° to 3000° K were determined by a Langmuir type method. The results show that a composition near 70 mol percent TaC - 30 mol percent HfC exhibits the lowest vaporization rate of any composition within this pseudobinary system. Variations in initial sample bulk density and vapor-specie condensation on the furnace wall have negligible effects on the measured vaporization rates. Preliminary information concerning the influence of time on the vaporization rate of selected compositions is discussed. Author

N65-35274*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS FOR CHAIN AND STEREO ISOMERS IN DIPROPYLENE GLYCOL BY GAS–LIQUID PARTITION CHROMATOGRAPHY
A. J. Havlik, D. E. Udlock, and D. D. Lawson 15 Apr. 1964 36 p refs
(Contract NAS7-100)
(NASA-CR-58225; JPL-TM-33-161) CFSTI: HC $2.00/MF $0.50 CSCL 07C

A study was made of the separation of dipropylene glycol (DPG) into its chain and stereo isomers by gas–liquid partition chromatography (GLPC). These materials were further characterized by adjunct analyses for hydroxyl, unsaturation, water, and propylene glycol contents, and by index of refraction, infrared spectrum, and bulk viscosity. For the qualitative analysis, packed columns, prepared with liquid phases of carbowax 20M, polyox WSR 35, or reoplex 400, and capillary columns, prepared with carbowax 1540, were used. For quantitative analyses, packed columns prepared with carbowax 20M were used. The quantities of the three chain isomers of DPG and the two diastereomers of one of the chain isomers were determined by the method of an internal standard. Significant differences in the isomer contents were observed. Author

N65-35287# Martin Co., Denver, Colo. Aerospace Div.
EVALUATION OF THE MECHANISM OF CORROSION IN CAPILLARIES Final Report
P. J. Pizzolato, B. K. Larkin, and C. C. Fatino 22 Jun. 1964 33 p refs
(Contract AF 04(647)-576)
(DSR-S-11077; CR-64-144; ME-627; AD-602782)

Corrosion mechanisms in a capillary of 2014 aluminum were studied. The corrosive media were products of the reaction between water and a fuel mixture of hydrazine and dimethyl hydrazine, and water and the oxidizer nitrogen tetroxide. Two displacement systems were used with these media. In one the capillary was first filled with water and later displaced by propellant, and in the other the capillary was first filled with propellant and later displaced by water. Two capillary configurations were used: a uniform cylindrical hole and a large cavity connected to a propellant tank by a narrow hole. No evidence of corrosion was found in specimens exposed to fuel and water. Of 89 specimens exposed to oxidizer and water, 60 showed no significant corrosion. The oxidizer corrosion process formed localized pits ranging in depth from 0.0004 to 0.012 inches. No intergranular corrosion was found. The oxidizer corrosion was more severe in the large cavity than in the uniform hole. Diffusion theory shows that corrosive media will not remain in capillaries more than two weeks. Experimental verification was obtained by both corrosion data and liquid analysis. R.N.A.

N65-35326# European Atomic Energy Community, Brussels (Belgium).
END-POINT CALCULATION OF THE BORIC ACID POTENTIOMETRIC TITRATION CURVE [CALCUL DE LA POSITION DU POINT FINAL DE LA COURBE DE TITRATION POTENTIOMETRIQUE DE L'ACIDE BORIQUE]
Y. Le Duigou 1965 5 p refs In FRENCH
(EUR-2240.f) CFSTI: HC $1.00/MF $0.50

The point of inflection of the curve describing the potentiometric titration of acid-base solutions is calculated. Numerical application is made for the titration of boric acid and sodium carbonate solutions, and suggestions concerning possible modification of the preparation methods are discussed. Transl. by G.A.L.

N65-35328# United Kingdom Atomic Energy Authority, Harwell (England).
CHROMATOGRAPHIC DETERMINATION OF TRACE QUANTITIES OF WATER VAPOUR IN A GASEOUS ATMOSPHERE
R. Aubeau, L. Champeix, and J. Reiss Jan. 1965 15 p refs Transl. into ENGLISH from J. Chromatographie (France), v. 16, no. 4, 1964 p 7–21
(NP-TR-1231) CFSTI: HC $1.00/MF $0.50

The content of water vapor in a gas by gas chromatography was determined by the direct method, single partition column, and the indirect method, conversion tube and an adsorption column. In the indirect method the water was first converted into acetylene or hydrogen and these gases were then separated from the other gases present by means of a silica gel column and a molecular sieve column. In the direct method the water vapor was separated from the other gases by means of polyethylene glycol. The tailing of the peak, due to adsorption on most of the usual supports, was considerably reduced when powdered teflon was used as the support for the stationary phase. By this means it was possible to determine amounts of 100 volumes per million or more of water vapor in a gas. By preliminary concentration on a pre-column of the same kind as the partition column, a sensitivity of 1 volume per million or even less can be attained. The direct method gives a precision of about 5 to 8%. Quantitative determination by the indirect method is lacking in precision because of the poor reproducibility. E.E.B.

N65-35332# Bureau of Mines, Boulder City, Nev.
ELECTROREFINING URANIUM IN A CHLORIDE ELECTROLYTE
R. E. Campbell and T. A. Sullivan Sep. 1964 12 p refs Prepared in cooperation with Lawrence Radiation Lab., Univ. of Calif.
(BM-RI-6624)

Uranium metal of improved purity was prepared by electrorefining commercial magnesium-reduced uranium in a molten sodium chloride-uranium trichloride electrolyte. Author

N65-35363# Mound Lab., Miamisburg, Ohio.
A REVIEW OF THE DISSOLUTION OF PLUTONIUM DIOXIDE
William S. Gilman 17 Sep. 1965 14 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1264) CFSTI: $1.00

The presently available dissolution data for plutonium dioxide have been compiled together with a bibliography on the subject. The ease of solubility in various media is strongly dependent upon the method of preparation and temperature to which the PuO_2 was subjected during ignition. Author

N65-35365# MSA Research Corp., Callery, Pa.
DEVELOPMENT OF TECHNIQUE FOR MEASUREMENT OF IMPURITIES IN SODIUM Progress Report No. 56-1, Period Ending Apr. 1965
R. C. Andrews and K. R. Barker 14 May 1965 9 p refs
(Contract AT(11-1)-765)
(MSAR-65-58)

New laboratory and instream techniques for the analytical determination of carbon, oxygen, and hydrogen contaminants in sodium are investigated. The laboratory techniques include high temperature mass spectrometry, magnetic effects, surface tension, and organic solvent extraction. The instream methods include physical property change of metals due to carburization, electrical sensing of particles, electrical potential concentration of sodium oxide, and continuous hydrogen monitoring. The technical philosphies used for each of the methods and progress to data are presented. R.N.A.

N65-35370# Du Pont de Nemours (E. I) and Co., Aiken, S. C. Savannah River Lab.
PURIFICATION OF RADIOACTIVE SOLVENT WITH A FLASH VAPORIZER
H. J. Clark and G. S. Nichols Apr. 1965 14 p refs
(Contract AT(07-2)-1)
(DP-849; CONF-611001-1) CFSTI: $1.00

A flash vaporization technique using superheated steam for decontaminating and improving the quality of degraded tributyl phosphate–kerosene solvent from a radiochemical separations plant was studied. The equipment is simple, requires a residence time of less than one second, and has satisfactory operating characteristics over a wide range of variables. Two 100-gallon charges of degraded solvent were processed through the test equipment at 100 pounds per hour with a 98 to 99% yield. The distillate contained less than 4% of the fission products present in the feed. Author

N65-35376# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID AND ITS DERIVATIVES. IV: PERCHLORIC ACID HYDRATES [KHLORNAYA KISLOTA I EE PROIZVODNYE. IV: GIDRATY KHLORNOI KISLOTY]
A. A. Zinov'ev and V. P. Babaeva London, Min. of Aviation, May 1964 16 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 2, no. 9, 1957 p 2188–2195
(RPE-TRANS-9) CFSTI: HC $1.00/MF $0.50

Viscosity and specific gravity have been determined for perchloric acid over the concentration range from 0 to 100 percent at temperatures of 20, 55 and 75° C. The existence in solution of the perchloric acid hydrates $HClO_4 \cdot 2.5H_2O$, $HClO_4 \cdot 2H_2O$, $HClO_4 \cdot 2.5H_2O$, $HClO_4 \cdot 3H_2O$ and $HClO_4 \cdot 3.5H_2O$ has been confirmed from the experimental data. It has been shown that both the mono- and the dihydrate exist in aqueous solution at 75° C. Author

N65-35386# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID: A REVIEW OF ITS THERMAL DECOMPOSITION AND THERMOCHEMISTRY
G. A. McD. Cummings and G. S. Pearson London, Min. of Aviation, Oct. 1963 32 p refs
(RPE-TN-224) CFSTI: HC $2.00/MF $0.50

Recent literature on the thermal decomposition of perchloric acid in both the liquid and vapour phases has been reviewed. Thermochemical data for perchloric acid have been critically examined. Because of the inadequacy of existing data for the determination of the latent heat of vaporization, the boiling point of the 72% acid was measured over a pressure range of 100 to 600 mm Hg. The best available values of the heats of formation of anhydrous perchloric acid and the 72% aqueous acid have been deduced:

Anhydrous perchloric acid $\Delta Hf_{298.1} = -9.29$ kcal/mole

$\Delta Hf_{298.g} = -1.12$ kcal/mole

72% perchloric acid

$\Delta Hf_{298.1} HClO_4, 2.17 H_2O = -173.90$ kcal/mole

$\Delta Hf_{298.g} HClO_4, 2.17 H_2O = -127.11$ kcal/mole.

Author

N65-35391# Pittsburgh Univ., Pa.
SINGULAR PERTURBATIONS OF BOUNDARY VALUE PROBLEMS ARISING IN THE STUDY OF CHEMICAL REACTORS
Louis Barton Freeman (Ph.D. Thesis) 1965 111 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-T-1801)

Solutions are presented for certain nonlinear boundary layer problems which approximately describe the physical situation in a chemical flow reactor. The problems are characterized by second order ordinary differential equations of the singular perturbation type. Approximate solutions were obtained, based on the idea of a boundary layer, and the domain was subdivided into an interior region and a boundary layer region. The isothermal problem for a single chemically reacting substance was solved in a similar manner, and the approximate closed form solutions were tested against available numerical results. The approach was extended to a temperature dependent problem for a single substance, with an Arrhenius temperature dependence of the chemical reaction rate. It was concluded that the boundary layer approach is feasible for obtaining approximate solutions to previously intractable problems, by splitting the single intractable equation into two simpler equations. M.G.J.

N65-35417# Los Alamos Scientific Lab., N. Mex.
PROCESSING OF PLUTONIUM BY ION EXCHANGE VII. PLUTONIUM (IV) DESORPTION KINETICS FROM DOWEX 1×4 INTO NITRIC ACID SOLUTIONS
D. B. James 10 Sep. 1965 22 p refs
(Contract W-7405-ENG-36)
(LA-3357)

The experimental desorption of uniformly-sorbed plutonium (IV) into nitric acid solutions from anion-exchange resin is duplicated by the theory for diffusion in spheres with a constant diffusion coefficient. For the various experiments the diffusion coefficient increases with increasing temperature, decreasing nitric acid in the aqueous phase, and decreasing initial level of plutonium sorption. Desorption into an aqueous phase of less than 0.6M nitric acid, even in the presence of hydroxylamine nitrate, causes the formation of insoluble plutonium polymer in the resin phase, and the desorption rate is controlled by the slow rate of polymer dissolution. One experimental desorption, with the nonuniform initial sorption that results from a short sorption time, indicates that such systems are not duplicated by the simple theory. Author

N65-35455# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID: NOTES ON ITS PROPERTIES AND SAFE HANDLING
A. R. Hall and G. S. Pearson London, Min. of Aviation, May 1964 56 p refs
(RPE-TN-232)

Some physical properties of aqueous perchloric acid are tabulated and plotted as graphs. The nature of the chemical reactivity of the acid is outlined. The salient principles to be observed in handling the acid in the laboratory are listed. A bibliography, with abstracts, of some of the articles which discuss the safe handling of perchloric acid is added, together with appendices giving the properties of the anhydrous acid and of some inorganic perchlorates. Author

N65-35467# Rocket Propulsion Establishment, Westcott (England).
RESEARCH ON PERCHLORIC ACID. PART I: RESEARCH ON PERCHLORIC ACID. PART II: SPECIFIC HEATS AND HEATS OF DILUTION OF PERCHLORIC ACID [RECHERCHES SUR L'ACIDE PERCHLORIQUE. I: RECHERCHES SUR L'ACIDE PERCHLORIQUE. II: CHALEURS SPECIFIQUES ET CHALEURS DE DILUTION DE L'ACIDE PERCHLORIQUE]
M. Berthelot London, Min. of Aviation, Sep. 1963 19 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 93, 1881 p 240–246, 291–292; Ann. Chim. Phys. (Paris), v. 27, no. 5, 1882 p 214–224
(RPE-TRANS-4)

The heat of solution of anhydrous perchloric acid is found to be −20.3 kcal. The heat of formation of the anhydrous acid is calculated to be −19.1 kcal. Values are calculated for the heats of formation and decomposition of ammonium perchlorate. The difference in the properties of anhydrous perchloric acid and the dilute acid is discussed and a thermochemical explanation is proposed. Specific heats for perchloric acid containing 3.085 to 590 moles of water are reported. Heats of dilution of $HClO_4 . nH_2O$, where the initial value of n varies from 0 to 200, for single and multiple step dilution up to n = 600, are given and the form of the dilution curve is discussed. Author

N65-35509# Portugal. Nuclear Energy Commission, Sacavem. Laboratório de Física e Engenharia Nucleares.
RADIOCHEMICAL PROCESSES IN IRIDIUM COMPLEXES. PART II: PRODUCTS FROM (w,γ) PROCESS IN AMMONIUM CHLOROIRIDATE
J. M. Peixoto Cabral 1964 15 p refs Presented at the Symp. on Chem. Effects Assoc. with Nucl. Reactions and Radioact. Transformations, Vienna, 7–11 Dec. 1964
(LFEN-29(β)) CFSTI: HC $1.00/MF $0.50

Additional experiments on the study of the effects of radiative thermal neutron capture in chloro complexes of iridium have shown that, in contradiction to earlier reports, all the products found in solutions of irradiated sodium chloroiridate crystals are also present in the solutions of ammonium chloroiridate irradiated under the same conditions. Three more species were further observed in the latter solutions which are very likely chloroammine and aquochloroammine complexes of iridium (III). It was shown too that the hydrolysis of chloroiridate is accelerated in the presence of NH_4^+ ions. Author

N65-35511# Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID AND ITS DERIVATIVES. V: PROPERTIES OF PERCHLORIC ACID AND METHODS FOR ITS PREPARATION [KHLORNAYA KISLOTA I EE PROIZVODNYE. V: SVOISTVA KHLORNOI KISLOTY I SPOSOBY EE POLUCHENIYA]
A. A. Zinov'ev London, Min. of Aviation, Sep. 1963 9 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 3, no. 5, 1958 p 1205–1209
(RPE-TRANS-6)

The properties of perchloric acid are briefly reviewed. The preparation of perchloric acid is discussed and a new method for the continuous preparation of the anhydrous acid is described with full experimental details. Author

N65-35525# National Academy of Sciences—National Research Council, Washington, D. C. Subcommittee on Radiochemistry.
THE RADIOCHEMISTRY OF RADIUM

H. W. Kirby (Monsanto Res. Corp.) and Murrell L. Salutsky (Grace (W. R.) and Co.) Dec. 1964 212 p refs
(NAS-NS-3057) CFSTI: $2.25

The nuclear and chemical properties of radium are reviewed, the methods of sample dissolution and of separation reactions are discussed, counting techniques are described, and radiochemical separation procedures are compiled. Metallic radium, soluble salts, insoluble salts, chelate complexes, non-extraction of radium by thenoyltrifluoroacetone solutions, extraction of radium with organic solvents, and ion exchange processes are included. Also, the inorganic and analytical chemistry of radium is discussed and the isotopes of radium are tabulated for mode of decay, half life, and source. E.E.B.

N65-35558# Phillips Petroleum Co., Idaho Falls, Idaho.
SOLIDS FLOW CONTROL FOR A PULSED SOLIDS-LIQUID CONTACTOR
Earl S. Grimmett and Noel de Nevers Mar. 1965 29 p refs
(Contract AT(10-1)-205)
(IDO-14648)

A solids transport and control system has been developed for a pulsed solids-liquid contactor. The system consists of a constant-flow-rate slurry feeder to feed the solids into the contactor and a constant-inventory slurry feeder to withdraw the solids from the contactor, both of which employ a fluidized bed for introduction of solids and a slurry gas lift to move the solids from the bottom of one contactor to the top of another. The entire system has been operated satisfactorily over a wide range of conditions circulating Dowex-50 ion-exchange resin. Author

N65-35563# Battelle Memorial Inst., Columbus, Ohio.
MEASUREMENT OF TRUE SURFACE AREA IN ELECTRODES Second Quarterly Technical Progress Report, 16 Mar.–15 Jun. 1965
J. Mc Callum, R. F. Redmond, and C. L. Faust 2 Jul. 1965 22 p refs
(Contract AF 33(615)-2225)
(BATT-7138-Q2; AD-617252)

The objective of this program is to understand and develop an electrochemical method for determining surface areas in porous electrodes. The measurement of the double-layer capacitance was selected as the most promising method. Further theoretical consideration was given to the matter of geometric effects resulting from the electrolyte resistivity. Such effects can affect the interpretation of double-layer capacitance measurements. Experimental work was concentrated on the improvement of equipment capability and measurement technique. Planned experiments are described which will demonstrate the geometric effects and test the theoretical predictions. These studies will help establish a measurement technique and a supporting theoretical framework for surface-area measurements. Author

N65-35586# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
RELAXATION THROUGH ANISOTROPIC CHEMICAL SHIFT IN POLYCRYSTALLINE UF_6
R. Blinc, E. Pirkmajer, I. Zupancic, and P. Rigny May 1965 5 p refs Submitted for Publication
(NIJS-R-453) CFSTI: HC $1.00/MF $0.50

A method for obtaining information on the screening constant tensors in UF_6 was developed, which depends on the anisotropies rather than on the relative chemical shifts. The technique involved field and temperature dependence measurements of the fluorine spin lattice relaxation times in polycrystalline UF_6. Results show that the same type of fluorine motion, which is responsible for the fluorine exchange between equatorial and axial sites, also dominates the spin lattice relaxation above 0° C, thus allowing an independent determination of the mean shielding anisotropy. Equations are given in support of the method, and the fluorine spin lattice relaxation rate is plotted as a function of the inverse square of the Larmor frequency at different temperatures. M.G.J.

N65-35590# Columbia Univ., New York.
THE HYDRIDE METHOD FOR THE RAPID DETERMINATION OF "FREE" WATER IN MINERALS Scientific Report No. 3
Necip Güven and Paul F. Kerr Bedford, Mass., AFCRL, Feb. 1965 19 p refs
(Contract AF 19(604)-8387)
(AFCRL-65-130; AD-617561)

A rapid procedure for the determination of 'free' water in minerals is described which makes use of the reaction: $CaH_2 + 2H_2O \rightarrow Ca(OH)_2 + 2H_2$. The pressure change caused by H_2 in the reaction is measured and the corresponding moisture content calculated. Parallel determinations using oven drying have been made in order to show the differences between the two methods. The hydride procedure measures only 'free' water whereas the conventional heating method includes both 'free' water and water of 'activated' adsorption and/or water of hydration involving adsorption energies greater than 5–10 Kcals per mole. Author

N65-35610# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry.
CHEMILUMINESCENCE IN ATOMIC REACTIONS AT LOW PRESSURES Final Report, 16 Mar. 1964–15 Mar. 1965
Paul Harteck, Robert R. Reeves, and Thomas Rolfes 20 May 1965 34 p refs
(Contract AF 19(628)-4069)
(AFCRL-65-253; AD-615626)

The chemiluminescent reaction of sulfur monoxide with oxygen atoms was studied in the micron pressure region and shown to be a simple combination:

$$SO + O \rightarrow SO_2 + h\nu.$$

This was analogous to the results previously obtained for the NO–oxygen atom reaction. Some thermodynamic considerations were given, as well as estimated reaction rates. The results of these experiments with NO and SO reacting with oxygen atoms confirm the two body combination as a probable mechanism for chemiluminescence. Additional studies on the afterglow of nitrogen atoms were made at low pressures, which indicated that a simple third order process does not dominate for the light emitting process under these conditions. Author

N65-35618# Maryland Univ., College Park.
AN INVESTIGATION DIRECTED TOWARD THE SYNTHESIS OF CYCLIC POLYPHENYLENES; THE CHEMISTRY OF 1, 3, 5-HEXATRIENE AND ITS DERIVATIVES; AND REACTIONS OF AMINES IN THE VAPOR PHASE OVER ALUMINA Final Technical Report
G. Forrest Woods Wright-Patterson AFB, Ohio, ARL, Mar. 1965 60 p refs
(Contract AF 33(657)-7833)
(ARL-65-55; AD-615900)

The results of the synthesis of intermediates which will be utilized in the attempted syntheses of ring polyphenylenes are reported. Experimental procedures have been devised and

preliminary work accomplished on an "all-meta-" hexaphenylene, an octaphenylene which contains both meta- and para-linkages, and a quinquephenylene which contains within the same molecule ortho-, meta-, and para-linkages. The possibility of migration of unsaturation through or across a benzene nucleus has been examined and tentatively it seems that this phenomena has taken place. The syntheses of the 1-,2-,3-chloro-1,3,5-hexatrienes have now been accomplished. The geometrical configuration of the less stable isomer of 1,3,5-hexatriene has been established by a stereospecific synthesis. The catalytic deamination reaction which in a rather formal way parallels the dehydration of alcohols has been explored. Author

N65-35623# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTOGRAPHIC PROPERTIES; STORAGE LIFE; AND PROCESSING OF EMULSION LAYERS OF NIKFI TYPE R (USUAL AND WITH GELATINS SUBSTITUTES)
M. Yu. Deberdeyev, T. I. Krestovnikova, K. M. Romanovskaya, and V. M. Uvarova 5 Apr. 1965 20 p refs Transl. into ENGLISH from Tr. Tret'yego Mezhdunarodnogo Soveshch., Yadernaya Fotogr. (Moscow), Jul. 1960 p 199–209
(FTD-MT-64-555; AD-615214)

Comparisons are given for the photographic properties of the usual gelatin emulsion layers, and layers in which part of the gelatin was replaced by surface-active material (p.a.v.). Test conditions are outlined for determining photographic sensitivity, stability of photographic properties and latent images, and the influence of temperature and humidity on stability. Also investigated was the dependence of the gluing ability of ordinary unbacked Type R emulsion layers, and layers with gelatin substitutes on the degree of tanning, plasticization, and storage time. The degree of heterogeneity of developed glued layers was also studied. The findings are discussed, and the data are graphically depicted. M.G.J.

N65-35633# Whirlpool Corp., St. Joseph, Mich.
WATER RECLAMATION FROM URINE THERMOELECTRIC SYSTEM Technical Report, May 1963–Oct. 1964
Duane C. Nichols Wright-Patterson AFB, Ohio, AMRL, Mar. 1965 27 p refs
(Contract AF 33(657)-11479)
(AMRL-TR-65-29; AD-615979)

This project was initiated to design, fabricate, and test a thermoelectric system for the recovery of potable water from urine in aerospace applications. The unit built is an integral system, which yields quality potable water at a performance factor of 146 watt-hours per pound. It has a capacity of processing 12 liters of urine per day with a batch size of 1 liter per run. Further development work should be undertaken toward obtaining better efficiencies, a decrease in size, and a reduction in weight. Author

N65-35723# Technical Operations Research, Burlington, Mass.
RESEARCH ON IMPROVING THE EFFICIENCY AND SPECTRAL RESPONSE OF PHOTOPOLYMERIZATION
Stanley Chaberek Apr. 1965 63 p refs
(Contract AF 33(615)-1104)
(TO-B-65-17; AFAL-TR-65-76; AD-615441)

The ultimate objective is the development of a nonsilver halide photographic process based upon photopolymerization. Work toward this goal was in three main areas: (1) study of the effects of viscosity on photopolymerization; (2) elimination of oxygen inhibition; and (3) evaluation of efficient visible-light-activated free-radical initiator systems. Studies into the kinetics of photopolymerization of acrylamide in gelatin slabs as a function of water content and the nature of the activator molecule showed that efficient polymer yields and molecular weights were obtained at water levels at 30% to 85%, but lower yields were obtained at lower water levels. Oxygen removal was investigated with bisulfite ion, oxygen-carrying metal chelates, and enzymes. Although the bisulfite approach appears useless, the other two procedures warrant additional investigation. Finally, a reevaluation of the kinetics and mechanism of photopolymer processes activated by acetylacetone and dimedon indicated that photoinitiation results from the reaction with the monomer of a light-excited thionine-β-diketone complex. Author

N65-35727# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELEMENTARY PROCESSES OF HIGH-ENERGY CHEMISTRY
V. L. Tal'roze and Ye. L. Frankevich 19 May 1965 8 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 7, 1963 p 113–114 Presented at a Symp. held in Moscow, 18–22 Mar. 1963
(FTD-TT-65-75/1; AD-617147)

Brief outlines of studies pertaining to the following topics are given: ionization and transformations of ions in highly heated gases; low temperature photochemical reactions, and hard-phase radiation polymerization; and principles of quantum generators and the elementary processes in them. G.G.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-34741 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE INNER GROUP STRUCTURE OF ONE AND MANY GROUPS OF A RANDOM NUMBER OF SIGNALS
I. A. Bol'sharkov *In its* News of the Acad. OF Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 148–157 refs (See N65-34725 23-34) CFSTI: $6.00

The problem of determination of the coordinates of a random number of signals is solved. A set of signals forms one or several groups which are characterized by general group parameters, and the set is used in a unique mixture with noise. The coordinates (for many groups also the parameters) are subject to the laws of random points. The optimal operators for formation of a posteriori characteristics are obtained and the principles of their operation are explained. Author

N65-34742 Joint Publications Research Service, Washington, D. C.
SYNTHESIS AND INVESTIGATION OF DISCRETE SYSTEMS INTENDED FOR CONTINUOUS MESSAGE TRANSMISSION. 2: INVESTIGATION OF THE OPTIMAL SYSTEM

A. I. Velichkin *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 158–169 refs (See N65-34725 23-34) CFSTI: $6.00

The statistical properties of an optimal discrete system are investigated. It is proved that in a discrete element of an optimal system there are independent signals. Taking this property into account the rate of information transfer, the mean square error, the probability density, the correlation function, and the spectral density of the value of the information in the output system, are determined. Author

N65-34743 Joint Publications Research Service, Washington, D. C.

STATISTICAL INVESTIGATION OF AN EXTRAPOLATION SYSTEM WITH NOISE SUPPRESSION BY MIXED METHOD ACCUMULATION

V. I. Stepanov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 170–183 refs (See N65-34725 23-34) CFSTI: $6.00

The operation of an extrapolation extremal system with suppression of noise by accumulation of the optimized parameter using a procedure which gives a combination of complex and variable accumulation methods, is investigated. An approximate expression is found for the steady state mean square error in finding the extremum. The type of random noise at the output of the object is indicated for which it may turn out to be suitable to apply a complex or mixed method of accumulation of the optimizing parameter. An investigation is carried out for an inertialess object with parabolic characteristics. Author

N65-34748 Joint Publications Research Service, Washington, D. C.

THE DYNAMIC CHARACTERISTICS OF RELAY TRACKING SYSTEMS

G. S. Pospelov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 239–255 refs (See N65-34725 23-24) CFSTI: $6.00

The transmission or reproduction properties of relay tracking systems are determined on the basis of investigation of equations in finite differences of the first approximation. These equations are obtained from the initial nonlinear equations in the finite differences and are equations in the small with respect to the periodic solution of nonlinear equations. It is shown that for a slowly varying input signal the reproduction properties of a relay system in the first approximation are equivalent to a pulse tracking system with a repeating period equal to the autooscillation period. Author

N65-34825 Rome Air Development Center, Griffiss AFB, N. Y.

BALLOON-SUPPORTED PLATFORMS IN COMMUNICATIONS

Charles A. Strom, Jr. and Cleo N. Lawrence *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 273–278 (See N65-34804 23-20)

This paper considers some possible uses of balloons to enhance the line-of-sight distances over which microwave radio frequency communications can be used. Both tethered and free-floating balloons are discussed as supporting platforms for both active and passive radio repeater stations. The broad needs of microwave radio communications are outlined and the more serious problem areas of applying balloon techniques summarized. Author

N65-34826 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

A BALLOON-BORNE MICROPHONE SYSTEM

John W. Coffman *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 281–293 refs (See N65-34804 23-20)

A balloon borne capacitor microphone for measuring low frequency background noise at high altitudes is described. The microphone has a coated mylar diaphragm and a large pressure reference chamber, and with its associated electrometer tube has a one volt output for an input of one dyne per cm^2. This high output was accomplished by means of the high compliance diaphragm and by using the electrometer as a stage of gain. The microphone also has a large area which lowers its electrical low frequency cutoff due to its increased capacity. The high sensitivity of the microphone was offset by two disadvantages. Large pressure oscillations caused the electrometer tube to bias itself to a cutoff condition, and the microphone sensitivity was a function of the ambient pressure because of the high compliance of the diaphragm. However, both difficulties were easily solved. The most severe constraint on the microphone design was the six-pound weight limitation. The instrument was used in the form described for many flights and several modified forms were developed for specific tests. It is easily adaptable to measuring variables other than pressure. R.N.A.

N65-34850# Aerospace Corp., El Segundo, Calif. Manned Systems Div.

LARGE UNFURLABLE ANTENNAS

P. L. Bargellini and R. L. Glasser 22 Jul. 1964 22 p refs (Contract AF 04(695)-469)

(TRO-469(5107-37)-1; AD-618021)

An investigation was conducted on a class of aperture antennas which are characterized by three fundamental parameters: half-power beamwidth, gain over isotropic, and ratio of the effective area to the geometric area. The areas that were investigated are: antennas in space; existing design proposals of unfurlable antennas for space environment; proposed structures for very large antennas; large space antennas as an MOL experiment; and structural problems of large antennas. R.W.H.

N65-34883# Naval Research Lab., Washington, D. C. Wave Propagation Branch.

RAY TRACING IN RISING AND FALLING DUCTS

N. W. Guinard, M. B. Laing, and K. W. Morin 22 Jul. 1965 30 p refs

(NRL-6253; AD-618371)

In studying signal transmission beyond the horizon by elevated duct propagation, estimates are needed of the losses. These estimates can be made by application of ray tracing for models of longitudinally varying ducts. A program was written in the NELIAC language for producing ray trajectories in an atmosphere which is variable in two dimensions. The program was run in the NAREC digital computer, and the resulting plots of the ray paths are used to analyze certain of the loss mechanisms in elevated ducts. Changes of the acceptance angle, i.e., refractive index gradient at a fixed altitude can cause continued losses. Changes in duct geometry causes losses which are a function of the height slope distribution at the point of change. Author

N65-34974*# Ball Bros. Research Corp., Boulder, Colo.

DESIGN, FABRICATION, TEST, AND FLIGHT OF BBRC TYPE SPC 300 SOLAR POINTING CONTROLS AND BBRC TYPE TEL 200 TELEMETRY SYSTEMS Final Report

R. L. Campbell 10 Mar. 1965 87 p
(Contract NAS5-1081)
(NASA-CR-67207; F65-2) CFSTI: HC $3.00/MF $0.75 CSCL 09F

The design, fabrication, testing, and flight data for three SPC 300 solar pointing controls and three TEL 200 telemetry systems suitable for use with specific scientific research instruments are summarized. The SPC 300 solar pointing control provides orientation of scientific instrumentation toward the center of the solar disc during the upper atmospheric portion of an Aerobee sounding rocket flight. The SPC 300B provides additional instrument restraint and shielding during reentry into the earth's atmosphere to enhance the possibility of successful parachute recovery. The TEL 200 telemetry system provides FM-FM radio transmission of instrument electronic data outputs, vehicle performance monitor outputs, and solar pointing control performance data outputs during the flight. R.N.A.

N65-34987# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADIOMETRIC FEED FOR HAYSTACK
A. Sotiropoulos 15 Jun. 1965 28 p refs
(Contract AF 19(628)-500)
(TN-1965-23; AD-618393)

This technical note describes a series of radiometric feeds in the 5.0 Gcps, 8.0 Gcps and 15.5 Gcps bands which were constructed and installed into the Haystack Cassegrain antenna system. Measured data are presented and also used to calculate the percentage of power intercepted by the subreflector and also the Cassegrain antenna aperture efficiency. Author

N65-35067*# National Aeronautiics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN ELECTRONIC MEANS OF PROVIDING BINAURAL INDICATION OF THE DIRECTION OF RADIO TRANSMISSIONS
Ray A. Torrey and Gilbert G. Robinson Washington, NASA, Oct. 1965 15 p refs
(NASA-TN-D-3062) CFSTI: HC $1.00/MF $0.50 CSCL 17C

The use of two hearing characteristics, by which humans normally detect the point of origin of a sound, is investigated as a means for detecting the point of origin of a radio signal. Provision was made to rearrange the audio output of a radio communication receiver in such a manner that the user, by listening to a pair of earphones, could determine the direction from which the transmission was coming. This device has potential application in providing orientation information to members of a space ship crew, or members of lunar exploration parties. A simulator with low power and lightweight equipment was developed to provide transmitter localization over short ranges. Author

N65-35108*# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
INTEGRAL SENSOR TELEMETRY Final Report
30 Jun. 1965 69 p ref
(Contract NAS8-11715)
(NASA-CR-67238) CSTI: HC $3.00/MF $0.75 CSCL 09F

An investigation was made of the feasibility of applying an integral sensor telemetry system to factory–stage checkout of a Saturn-type vehicle, and requirements are defined for a system which could be used. Five presently available transmitters were found to meet the operational, environmental, and mechanical specifications required for the system. An integral sensor transmitter test procedure is evolved, and the interpretation of error measurements is considered. Test results with each of the transmitters are tabulated. Operating and maintenance instructions for the system deal with transmitter installation and calibration, and receiver station components and installation. A data recovery unit calibration curve is included. Based on the above results, development of a five-channel miniature telemetry system has been undertaken, and five sensor transmitters were fabricated. M.W.R.

N65-35165# Collins Radio Co., Cedar Rapids, Iowa.
TACAN/DME MONITOR EQUIPMENT Final Report
J. H. Sprengeler Oct. 1964 27 p
(Contract FAA-ARDS-483)
(SRDS-RD-64-137)

Monitoring equipment was developed for tactical air navigation-distance measuring equipment. Major objectives of reliability, accuracy, testing and maintenance, and fail-safeness; and methods and techniques used to achieve the stated objectives are discussed. A brief discussion of the salient features of each monitor unit, together with a summary of the characteristics of each unit are given. The mean-time-between-failure prediction and the method employed in its calculation are discussed. Production test data, type test data, and a detailed test procedure are included. On the basis of the data submitted herein, and as a result of the various electrical and mechanical design techniques employed, it is believed that the stated objectives were achieved in the monitoring equipment. R.N.A.

N65-35189# Library of Congress, Washington, D. C. Aerospace Technology Div.
TRACKING OF MISSILES AND SPACE VEHICLES Surveys of Soviet-Bloc Scientific and Technical Literature
14 Sep. 1965 52 p refs Compilation of abstracts
(ATD-P-65-51)

Soviet-bloc literature dealing with ion clouds and ionic perturbations, radio emissions and antennas, and lasers and masers is reviewed in a series of abstracts. A bibliography of related articles is appended. M.W.R.

N65-35224*# Michigan Univ., Ann Arbor. Radiation Lab.
HIGH FREQUENCY SCATTERING FROM A COATED CYLINDER
P. L. E. Uslenghi [1963] 13 p refs Submitted for Publication
(Grant NsG-444)
(NASA-CR-56926) CFSTI: HC $1.00/MF $0.50 CSCL 17N

The scattered field produced by a plane electromagnetic wave incident on an infinitely long imperfectly conducting cylinder coated with a layer of material with complex index of refraction is considered. The geometric optics and the creeping wave contributions to the back scattered field are obtained, for normal incidence and small wavelengths. Author

N65-35253*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH POWER CW RADAR TRANSMITTER
Walter S. Baumgartner, [1965] 59 p
(Contract NAS7-100)
(NASA-CR-59047) CFSTI: HC $3.00/MF $0.50 CSCL 09F

This paper is principally concerned with a description of an operational high power CW radar transmitter, but to properly orient this transmitter in the NASA-JPL space program some preliminary discussion of the space telecommunications problem, the existing Deep Space Net, and in particular the continuing program of advanced system development will be presented. The system in which the transmitter functions is

described and its use as a planetary radar and as a proving ground for equipment is discussed. The design parameters for such a transmitter are delineated and the history of its development is traced. Particular attention is given to problems encountered and their solutions. There is a detailed description of the hardware involved with several diagrams and photographs. The present plans for increasing the radiated power still further and upgrading the transmitter system in general are presented. Author

N65-35259*# California Univ., Berkeley.
EFFICIENT RECURSIVE ESTIMATION OF THE PARAMETERS OF A COVARIANCE FUNCTION
David J. Sakrison [1963] 34 p refs Submitted for Publication (Grant NsG-354)
(NASA-CR-58090) CFSTI: HC $2.00/MF $0.50 CSCL 17B

Considered were sequential observations of a zero-mean gaussian process. It was assumed that the successive observations were identically distributed and statistically independent of each other. The known functional form of the covariance function and the sequence of observations were used to estimate the values of the parameters which pertain to the process being observed, and a modified Robbins-Munro method was employed to find estimates that were asymptotically efficient. G.G.

N65-35299# IIT Research Inst., Chicago, Ill.
ENGINEERING STUDY FOR ELECTRICAL HULL INTERACTION Technical Memorandum, 2 Jan.–1 Sep. 1964
Marvin J. Frazier [1964] 253 p refs
(Contract N123(953)35417A)
(IITRI-56013-9; AD-461636)

Laboratory testing showed both non-linear junctions and magnetic materials to be potential sources of shipboard interference. A technique for mathematically approximating the characteristics of non-linear junctions was devised. General expressions were derived for the non-linear product magnitudes resulting from the excitation of devices whose characteristics can be approximated by the proposed technique. Study of the differences between the theoretical expressions for non-linear products from junctions and magnetic materials led to the development of tests which could be used to distinguish the type of non-linearity under test. Tests uncovered several junctions which were contributing significantly to the interference environment. Radiated tests tended to indicate that steel was a contributing factor to the non-linear environment, however, shielding experiments performed on the antenna matching network boxes were inconsistent. A new device for testing non-linear junctions in high-impedance circuits was designed, constructed, and tested. Author

N65-35314*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE VEHICLE SA-3, TELEMETRY SYSTEM
W. B. Threlkeld, Jr. and E. H. Reeves, Jr. 26 Nov. 1963 49 p (NASA-TM-X-51865; MTP-ASTR-I-63-17) CFSTI: HC $2.00/MF $0.50 CSCL 09F

The performance evaluation of the complete telemetry system (ten links) used for flight testing Saturn vehicle SA-3 is presented. The eight operable telemetry links, the two experimental telemetry links, and the telemetry (TM) auxiliary equipment assembly have been technically analyzed on an individual basis. Statistical analyses were performed on much of the telemetry data and results of these analyses are presented. No RF signal fade or dropout difficulties were encountered on any of the links. It is concluded that the overall performance of the telemetry system used for flight testing SA-3 was as anticipated. It is inferred that the derived test data will facilitate the development of more efficient telemetry systems. Author

N65-35476*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROCEEDINGS OF THE APOLLO UNIFIED S-BAND TECHNICAL CONFERENCE
Washington, NASA, 1965 277 p refs Conf. held at Goddard Space Flight Center, 14–15 Jul. 1965
(NASA-SP-87) CFSTI: HC $3.00/MF $1.50 CSCL 17B

This report contains a reasonably comprehensive description of the primary equipment used at the Apollo ground stations. For individual titles see N65-35477–N65-35504.

N65-35477* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FUNCTIONAL DESCRIPTION OF UNIFIED S-BAND SYSTEM AND INTEGRATION INTO THE MANNED SPACE FLIGHT NETWORK
W. P. Varson *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 3–12 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The lunar phases of the Apollo missions require techniques and equipment exceeding the capability of those previously used in the Manned Space Flight Network. This improvement in network capability is necessary to provide reliable tracking and communications of the Apollo spacecraft at lunar distances. To fulfill this requirement, the unified S-band (USB) system has been introduced into the network. The USB system used with 85-foot antennas will provide the only means of tracking and communications at lunar distances. The USB system with 30-foot antennas will be used to fill the gaps in the coverage provided by the three 85-foot antennas. The USB system with the 30-foot antennas will also be used to provide data during the earth-orbital and post-injection phases of the missions. In order to insure reliability, the USB system utilizes existing, proven techniques and hardware. These items of equipment developed and used by the Jet Propulsion Laboratory and the Scientific Satellite Network have been adapted to the USB system. The more significant of this equipment is the range and range rate equipment supplied by the Jet Propulsion Laboratory to the program and the antenna systems which are nearly identical to those used in the Scientific Satellite program. Author

N65-35478* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRACKING STUDIES FOR PROJECT APOLLO
W. D. Kahn *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 13–20 refs (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

A tracking error analysis study is presented in which the earth orbital, translunar, lunar, and transearth phases of the Apollo Mission are considered. Principal error sources, such as measurement random errors, measurement bias errors, and errors in tracking station location, are analyzed to determine how well a tracking network such as the Manned Space Flight Network (MSFN) can determine the orbit of the spacecraft. Results of an error analysis study considering tracking of the spacecraft during all the different phases of the Apollo Mission are described. Specifically, tracking during the earth orbital, translunar, lunar, and transearth phases are simulated in this study. Author

N65-35479* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USB ANTENNA STRUCTURES
L. E. Hightower *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 21–27 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

This paper describes the main features of the unified S-band antennas, their design considerations, characteristics, parameters, functions, and modes of operation. Description covers both land-based and shipboard antennas, specifications, and maintenance problems. Both Rosman and Apollo antennas are treated. Author

N65-35480* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USB SERVO SYSTEM
N. Raumann *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 29–38 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

A unified S-band (USB) servo control and drive subsystem has been designed and is being presently developed. The intent of this discussion is to present an overall view of the subsystem and its anticipated capabilities. The text includes, as an introduction, a general description of the servo control and drive subsystem, the system's principal modes of operation and its required sky coverage. More specific discussion on the dynamic behavior of the system follows the introductory portion. Finally, some preliminary results are given and the present status of the subsystem is discussed. Author

N65-35481* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANTENNA FEEDS AND ACQUISITION ANTENNAS
J. Flowers *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 39–45 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

This paper presents the history and a technical description of the Apollo Cassegrainian Feed System and Acquisition Antenna. Characteristics of the feed and acquisition antenna systems are discussed, including design considerations, configuration, constraints, parameters, and interfaces with the Cassegrainian feed system and the more conventional focal-point feed system. Discussion includes the 30-foot antennas, and the feed and acquisition antenna systems for the projected 85-foot dishes. Also described are typical receiving patterns, the method of TE_{12}/TM_{12} mode excitation, efficiency factors, and various packaging problems. Author

N65-35482* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PARAMETRIC AMPLIFIER, AND NOISE FIGURE AND TEST SIGNAL NETWORK
J. B. Martin *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 47–57 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

Parametric amplifiers are used to provide a low system noise temperature for both the main tracking and acquisition antennas. Identical units are used to simplify maintenance and allow substitution in-an emergency. A noise temperature of 170° K degrees is achieved without cooling. The units are housed in weatherproof, pressurized containers to allow mounting without weather protection. It is important to determine system readiness for operation without disabling the equipment. The Noise Figure and Test Signal network is designed to measure noise figure or inject test signals while the receivers are connected to the antenna terminals. This arrangement also allows more realistic tests of signal threshold since the effects of antenna temperature and sky noise are included in the measurement. Author

N65-35483* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RECEIVER–EXCITER SUBSYSTEM
R. C. Bunce *In* NASA. Goddard Space Flight Center Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 59–73 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The receiver–exciter subsystem, MSFN version, may be described as nine functional units interfacing with nine external subsystems. The prime interunit and interface signals, gross frequencies, levels, and functions are initially presented in diagram form. Following the initial description, six functional block diagrams showing the mechanization within the functional units in greater detail are also presented. Finally, photographs and diagrams showing equipment layout within the cabinets and views of the control panels are included, and functions of of the important controls and indications are explained. Author

N65-35484* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VERIFICATION RECEIVER, SCO OSCILLATOR AND UP-DATA MODEMS
J. Jacobi *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 75–81 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The verification receiver is a solid-state, S-band telemetry receiver with special demodulators. It is a fixed-tuned superheterodyne, multiple-conversion receiver of standard design. The purpose of the verification receiver is to sample the uplink signal at the power amplifier output and provide demodulated voice and data signals. The voice signal is recorded and the data is utilized by the command system as an input to the verification loop. The subcarrier oscillator (SCO) subsystem comprises a 30-kilocycle voltage controlled oscillator (VCO) and appropriate mixing networks. The 30-kilocycle SCO is modulated with voice and the 70-kilocycle SCO is modulated with data. The two resulting signals are added linearly and modulated onto the S-band carrier. The up-data modem (modulator-demodulator) accepts a command message from a modified Univac 642B computer and converts it to a form suitable for modulating onto the 70-kilocycle SCO. Author

N65-35485* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIGNAL DATA DEMODULATORS
G. Hondros *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 83–90 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

This paper presents an overall view of the function and capabilities of the signal data demodulator which is an integral part of the heart of the Unified S-Band system. The text includes a general discussion of the different types of demodulators. Then, more specific discussion follows explaining in detail the dynamic behavior of each demodulator, tabulation of parameters, operational procedures and integration of the demodulators with the rest of the Unified S-Band system. Author

N65-35486* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE UNIFIED S-BAND POWER AMPLIFIER

T. E. Mc Gunigal *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 91–98 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

This paper reviews the salient specifications of the 10-kilowatt power amplifier including its interface characteristics and actual performance characteristics determined during the acceptance tests. Special emphasis is given to the RF performance and the more difficult RF tests are discussed. Metering and control circuit operation is covered in the light of the Apollo mission operational requirements. An overall block diagram of the amplifier is included. Author

N65-35487* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RANGING SUBSYSTEM—MARK I
P. Lindley *In* NASA, Goddard Space Flight Center Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 99–107 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

This presentation covers the functional characteristics of the Mark I ranging subsystem including its general description, parameters, constraints, and interfaces with other subsystems of the ranging complex. The following main functions of the Mark I are discussed: Code generation and synthesis, code synchronization, code shifting, doppler detection, range tallying, output, ranging code acquisition and tracking, and range monitoring. Author

N65-35488* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHIPBOARD DOPPLER COUNTER, ANTENNA PROGRAMMER, AND TRACKING DATA PROCESSOR
W. Hocking *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 109–124 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

This paper describes three subsystems within the Unified S-Band System: the antenna position programmer (APP), the tracking data processor (TDP), and the shipboard doppler counter (SDC). The discussion includes the relationship of these subsystems to all interfacing subsystems of the overall S-band system, and detailed description of their functions and mode of operation. Range and range-rate data problems and characteristics are also treated. Author

N65-35489* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO PRECISION FREQUENCY SOURCE AND TIME STANDARD
R. L. Granata *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 125–134 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

A brief description is given of the Apollo *precision frequency source* and *time standard*. The *precision frequency source* will be the source of accurate frequency reference for the Apollo time standard, S-band ranging system, tracking data equipment, and other site functions. This unit contains four frequency references, two rubidium resonators and two crystal resonators. These four sources are processed through combiner circuitry and distributed throughout the S-band system. A brief description of the operation of this equipment is discussed. The Apollo *time standard* will be utilized to generate station time and to correlate station and spacecraft events. The Apollo time standard consists of redundant clocks and time-code generators to enhance reliability. Various time codes and standard frequencies are generated by this equipment for use by the S-band system. Peripheral instrumentation is also included with this system to aid in synchronizing the network to a common source. Time synchronization is established with the National Bureau of Standards Station, WWV, and frequency correlation is maintained to one part in 10^{10} with VLF techniques. Author

N65-35491* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPUTER TEST PROGRAM TO QUALIFY USB SYSTEM
J. Barsky *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 145–150 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The GSFC computer processor will utilize data from the Unified S-Band (USB) System to document its operating characteristics during actual orbital track. The USB system will be calibrated by the C-band network of FPS-16 and FPQ-6 radars which have been proven in Mercury and Gemini. The basic computer program utilized will be the Gemini program, revised to receive and process the outputs of the two systems both simultaneously and separately to allow for maximum comparison of the results. The results will be measurements of the noise and bias in the USB network and the orbital determination accuracy as a function of this noise and bias. System testing of data flow to and from a USB site conducted at GSFC will utilize developed tests from the CADFISS program. These tests will be used to determine (1) the degree to which the computer-related portions of the system have fulfilled their system design requirements, (2) those portions of the systems which are not functioning properly, and (3) the operational capability of the system to support a mission. Author

N65-35492* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NETWORK SYSTEMS
C. O. Roberts *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 151–164 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

This presentation outlines the configurations and capabilities of the network equipment to be installed on the remote sites for the Apollo program. Discussion includes site and system design considerations, system parameters, functions, and modes of operation. The major systems, including PCM decom telemetry and DCS processors and console systems, are described in detail. The discussion also includes the capabilities to be provided for closed-loop tests of the equipment at the remote stations, and the design of the equipment required to process and distribute the data from the United S-Band System. The data flow from the control center to the remote sites is described, as well as equipment arrangement at a typical remote site. The quantities and types of new network equipment being procured for the Apollo project are listed to provide an indication of the magnitude of the Manned Space Flight Network (MSFN) implementation program for the Apollo project. Author

N65-35493* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO NETWORK PCM DECOMMUTATION SYSTEMS
W. A. Dentel *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 165–179 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

A description of the MSFTP-1 (PCM) decommutation systems currently being utilized on the Manned Space Flight Network (MSFN) is presented, including a discussion of the signal conditioner, the group synchronizer, and the telemetry output buffer and its capabilities. A description of the new

stored program PCM decommutation systems being procured for the MSFN is also presented. In addition, the added versatility of the stored program and its associated software will be discussed. The two types of systems are discussed with respect to the interfaces with the other on-site equipment, including unified S-band (USB), VHF receivers, computers, and consoles. Author

N65-35495* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO DIGITAL COMMAND SYSTEM
C. B. Knox *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 191–203 ref (See N65-35476 23-07) CFSTI: HC $3.00/MF $4.50

The presentation explains the purpose of the command system, the command word structure, the on-site equipment configuration, and the operational capabilities of the command system. The purpose of the command system is explained utilizing typical commands employed during a mission. Different Apollo/Saturn command types are also itemized for each vehicle. An explanation of the command word structure demonstrates how each vehicle and vehicle system is addressed and updated. This explanation will also include the purpose and use of the sub-bit codes and error codes used in the Apollo command system. Diagrams are utilized to present the on-site equipment configurations and how they participate in the command system. The discussion will include the function, associated capability, and purpose of each unit in the system. The operational capabilities and procedures will also be presented. In conclusion, the presentation will discuss a typical data transmission from its origin at the control center to the transmission at the remote site. Author

N65-35497* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
COMMAND AND SERVICE MODULE UNIFIED S-BAND SYSTEM
B. Hood *In* NASA. Goddard Space Flight Center Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 223–232 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The basic communications and tracking requirements for the Command and Service Module Unified S-Band System are given along with a brief discussion of the reasoning behind these requirements. The operational modes, which include simultaneous transmission of a pseudo-random noise (PRN) range code, TV, voice, telemetry and biomedical data and system configuration that evolved from these requirements, are considered. Such things as modulation techniques, major systems, and basic data flow for these are outlined along with the modes of operation and system configuration. A more detailed description for the major systems is then presented, including block diagrams and data flow and key parameters of the premodulation processor (PMP), transponder, power amplifier and antennas. Author

N65-35498* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LUNAR EXCURSION MODULE UNIFIED S-BAND SYSTEM
W. Kuykendall *In* NASA. Goddard Space Flight Center Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 233–242 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

A description of the basic S-band communication and tracking requirements for the in-flight and lunar phases of the LEM operation is given. Modulation techniques and associated RF spectra for various communication modes involving voice, telemetry, TV, and ranging are presented. RF systems, including the transponder, power amplifier, diplexer and antennas (omni, steerable, and erectable) are discussed. Current estimates of system gain and loss parameters are presented along with predictions of system performance at lunar distance. Author

N65-35499* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
UNIFIED S-BAND RF SYSTEM COMPATIBILITY TEST PROGRAM
A. Travis *In* NASA. Goddard Space Flight Center Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 243–245 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The background, history, and present status of the Unified S-Band RF System compatibility program are presented. A diagram of the test configuration is furnished and the equipment utilized in testing is outlined. The tests which have been accomplished are enumerated and the general results are given. Author

N65-35500* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMMAND AND COMMUNICATION SYSTEM
B. Reed *In* NASA. Goddard Space Flight Center Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 247–260 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The Command and Communication System (CCS) consists of a transponder, power amplifier and antenna system. The CCS is located in the S-IVB instrument unit and is capable of up-data command, down-link telemetry and turn-around ranging. A brief description of each stage of the Saturn V vehicle is presented. The S-IVB is the third powered stage of the Saturn V vehicle and separates from the Apollo spacecraft at a distance of approximately 20,000 nautical miles from the earth. The operational requirements of the CCS during the period up to and including separation are described. This consists of the launch, parking orbit insertion, and injection phases of the Apollo mission. Electrical and environmental specifications of the CCS are presented. The errors in the transponder due to doppler shift and doppler rate are tabulated versus input signal level. Loop bandwidth and suppression factor versus signal level are also included. The CCS omni- and directional antenna system and their switching and coupling networks are described. A system analysis is presented and gain margins are tabulated for the up-data link, down telemetry link and the RF carrier. Author

N65-35501* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TYPICAL ACQUISITION PROCEDURE
R. H. Newman *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 261–268 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The problem of acquisition is considered from the ground operational aspect during earth orbit for each of the following tasks: (1) spacecraft illumination, (2) two-way RF acquisition, (3) data acquisition, (4) range acquisition, (5) angle acquisition, and (6) station-to-station hand-over. The time required to perform each of these tasks, total acquisition summary chart, and ground acquisition aids are discussed. Author

N65-35502* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

IMPACT OF APOLLO UNIFIED S-BAND SYSTEM ON NASA COMMUNICATIONS NETWORK

W. Dickinson *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 269–274 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

The engineering aspects of the data communications buildup required of the NASA Communications Network in order to support the Apollo Unified S-Band (USB) System are presented. USB system needs for a worldwide high-speed data transmission capability in terms of sites, circuit facilities, data rates, and transmission system reliability, flexibility, and restorability are outlined. The specific hardware being used to build the system is described, including HF radio and wireline data modems, data error-detection and correction equipment, data error-detection terminals, data quality monitors, audio (circuit) and digital (data) switching systems and data technical control and test systems. Performance design goals of the final network and the capability for expansion of the present network are discussed. Author

N65-35505# Royal Aircraft Establishment, Farnborough (England).

POWER BEHAVIOUR OF THE ANTENNAS OF A SATELLITE LAUNCHER IN A RARIFIED ATMOSPHERE [TENUE EN PUISSANCE DES AERIENS D'UN LANCEUR DE SATELLITES EN ATMOSPHERE RAREFIEE]

C. Ancona and Do-Boi-Hoan Jul. 1965 22 p refs Transl. into ENGLISH from L'Onde Elec. (France), No. 451, Oct. 1964 (RAE-LIB-TRANS-1121) CFSTI: HC $1.00/MF $0.50

Under low pressure conditions as experienced during a missile flight, radio frequency corona breakdown of aerials takes place at much lower powers than at ground level. This paper describes the basic phenomena involved and presents experimental results for L shaped unipoles in the U.H.F. frequency band. A theoretical assessment of the corona breakdown performance of the L shaped unipoles is carried out showing good agreement between theory and practice. It is shown that, by applying a d.c. potential to the aerial its power handling capability can be considerably increased. Author

N65-35532# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEM OF SCATTERING OF ELECTROMAGNETIC WAVES ON AN UNEVEN SURFACE

Yu. P. Lysanov 5 Aug. 1965 10 p refs Transl. into ENGLISH from Dokl. Akad Nauk SSSR (USSR), v. 87, no. 5, 1952 p 719–722

(FTD-TT-65-568/1+4; AD-619327)

The problem of the scattering of plane electromagnetic waves on an absolutely conductive uneven surface is solved. A generalization of the solution of the problem for the case where the lower medium is characterized by the final conductivity and the complex dielectric constant. In this case the coefficient of reflection will be a function of the angle of incidence, or, since the surface is uneven, a function of a point of the surface. Author

N65-35611# Michigan Univ., Ann Arbor. Radiation Lab.

THE MINIMIZATION OF BACK SCATTERING OF A CYLINDER BY DOUBLE LOADING Scientific Report No. 4

Kun-Mu Chen Apr. 1965 37 p refs *Its* Rept.-5548-4-T (Contract AF 19(628)-2374)

(AFCRL-65-254; AD-615538)

A theory on the minimization of the back scattering of a cylinder by loading a cylinder at two points with lumped impedances is presented. The induced current on a doubly loaded cylinder when illuminated by a plane electromagnetic wave at an arbitrary angle is obtained. The optimum loading to eliminate the broadside back scattering which is caused by the symmetrical component of the induced current is established. A suitable loading to reduce the off-broadside back scattering, due to the antisymmetrical component of the induced current, is also determined. A proper choice of the impedance and the position of double loading can lead to the reduction of the back scattering over a wide aspect range. The useful formulas for optimum loading and some graphical illustrations are included. The advantages of double loading over central loading are discussed. Author

N65-35631# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.

SMALL SAMPLE SEQUENTIAL DETECTION OF RICEAN DISTRIBUTED SIGNALS

Joseph Wakeley, Jr. Jun. 1965 61 p refs

(Contract AF 49(638)-1402)

(PIBMRI-1248-64; AFOSR-65-0154; AD-615545)

This paper is concerned with a method of evaluating small average sample size (1.0 to 1.2) sequential detection of Ricean distributed signals. A. Wald has formulated useful approximations for this method of testing using large average sample sizes; however, his relationships do not hold for small average sample sizes. A solution is presented for this method of testing, and the results compared to Wald's approximation. In addition, this testing method is compared with fixed sample size and null-zone detection (sequential test without memory). The results show that sequential detection has a significant improvement over fixed sample testing, and may be approximated by the null-zone detector for small average sample sizes. Some remarks are included on truncating the sequential detector after the second sample. Author

N65-35634# Harvard Univ., Cambridge, Mass. Cruft Lab.

[VERY LOW FREQUENCY PROPAGATION, ELECTRON AND SOLID STATE PHYSICS, AUTOMATIC CONTROL, COMMUNICATIONS AND NETWORKS, ELECTROMAGNETIC RADITION] Semiannual Progress Report, 1 Jul. 1963–1 Jan. 1964

20 May 1964 68 p

(Contracts Nonr-1866(07); Nonr-1866(16); Nonr-1866(28); Nonr-1866(32))

(SAPR-67; AD-614130)

Presented are data on: very low frequency propagation, electron and solid state physics, automatic control, communications and networks, and electromagnetic radiation. R.W.H.

N65-35647# Illinois Univ., Urbana. Radiolocation Research Lab.

ELECTRONIC OBSERVERS FOR RADIO DIRECTION FINDING Technical Report No. 11

Robert Sterling Smith Feb. 1965 97 p refs

(Contracts NObsr-64723; NObsr-89229)

(RRL-273; AD-613039)

Automated bearing readout methods are investigated for the Wullenweber wide-aperture radio direction finder, with particular attention to the effects of amplitude modulation on bearing readout. An examination of a generalized RDF system is given to show the potential effects of the various components on bearing readout accuracy, and the state-of-the-art in

RDF systems and readout methods is reviewed. The Wullenweber wide aperture set is described in detail. Some statistical characteristics involved in readout problems are discussed, and the three basic requirements for the application of Wiener's work in time series are noted, along with the nature of the output ensemble from the DF receiver. Tchebysheff's inequality is applied to the prediction of sample size requirements, and some sampling rate considerations are noted in the light of the predicted sample sizes. A computer routine was written to compare the accuracies and speeds of three methods of computing bearings from the output of the DF set. A discussion of data handling characteristics applied to RDF systems is given, and the conclusions reached are applied to the design and construction of an extensive automatic data handling system.
Author

N65-35662# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
ON THE RESOLVING POWER OF GROUND MAPPING RADAR ANTENNAS
J. F. Mc Ilvenna and C. J. Drane, Jr. May 1965 59 p refs *Its* Physical Sci. Res. Papers No. 104
(AFCRL-65-322; AD-617254)

The mapping of extended, cultural ground targets by an airborne radar is examined using communication theory concepts including those of the antenna transfer function and the target spatial frequency spectrum. Use of the set of transfer functions that correspond to Taylor aperture distributions and specification of the targets directly in terms of their spatial frequency spectra, permits one to examine the antenna images for quality and resolution. The results obtained indicate that resolution for a class of ground targets can be much better than is predicted by the two-point Rayleigh resolution criterion. It is also true that there can be situations in which the shape of the antenna images are quite independent of the radiation pattern. Several types of spatial noise were also included in the input spectrum to investigate noise effects on image quality and resolution.
Author

N65-35674# Naval Ordnance Test Station, China Lake, Calif.
A THEORETICAL CONTINUOUS WAVE (CW) MULTIPATH ANALYSIS FOR WAVELENGTHS FROM 3 TO 10 CM
Richard S. Hughes Aug. 1965 144 p refs
(NAVWEPS-8725; NOTS-TP-3776; AD-617535)

A CW sensor approaching a transmitter is beset by two basic problems: signal multipath and sensitivity. This report is intended to give some insight into the problem of signal multipath. It is felt that only the bistatic reflection (that reflected from a building, radar van, house, etc.) is of primary concern. A doppler shift is associated with this reflection. Appendix B contains a complete set of curves of the doppler shift for various sensor-reflector-transmitter configurations.
Author

N65-35703# Ohio State Univ., Columbus.
DETAILED DATA ANALYSIS OF ECHO I, ECHO II, AND MOON REFLECTED SIGNALS. VOLUME 2: AUTOCORRELATION FUNCTIONS OF ECHO II REFLECTED SIGNALS
J. W. Eberle and S. L.-Zolnay Griffiss AFB, N. Y., RADC, May 1965 35 p refs
(Contract AF 30(602)-2166)
(RADC-TR-65-68, Vol. 2; AD-616532)

Short-term autocorrelation function of Echo II passive satellite reflected signals are investigated. Sample signal lengths were 30 seconds; maximum time delays were in the order of three seconds. Autocorrelation functions were obtained from pulsed and cw signals, at sampling rates of 29, 50, and 100 per second during different revolutions and with the satellite in various path geometries. Adaptation of the autocorrelation function computations to digital techniques is considered, and two methods of linearizing obtained data are presented. An expression is derived for the specular-to-spattered power ratio, and the inverse transform of the function is considered. Qualitative analysis is made of the Fourier transform. Surface roughness of the reflector, discrete fading rates, and fading frequencies are discussed.
M.W.R.

N65-35705# Michigan Univ., Ann Arbor. Radiation Lab.
SURFACE FIELD COMPONENTS FOR A PERFECTLY CONDUCTING SPHERE Scientific Report No. 3
John A. Ducmanis and Valdis V. Liepa Mar. 1965 100 p refs *Its* Rept.-5548-3-T
(Contract AF 19(628)-2374)
(AFCRL-65-184; AD-615368)

For a plane wave incident on a perfectly conducting sphere of radius a, the surface field components are expressible in terms of series of the Mie type. These have been evaluated on an IBM 7090 computer, and results are presented for $\theta = 0(5)180°$, where θ denotes the angular position on the surface, and $ka = 0.1(0.1)5.0(0.2)10.0$, where k is the propagation constant.
Author

N65-35707# Mitre Corp., Bedford, Mass.
AN EFFICIENCY FUNCTION FOR RATING MECHANICAL SCAN-TRACK RADARS
James W. Mc Ginn, Jr. Mar. 1965 22 p refs
(Contract AF 19(628)-2390)
(W-07109; ESD-TR-65-80; AD-614477)

A function, (P_d) is derived as a measure of effectiveness in rating certain mechanical scan-track radar configurations in the joint performance of two operational requirements. These are: confirmation, i.e., acquisition and tracking of objects (missiles and/or satellites) detected by collocated surveillance radars, and scanning, i.e., providing additional surveillance coverage for a missile threat in a sector not searched by the collocated surveillance radars. We are mainly interested in the application of the P_d function to the problems of selecting a suitable scan-track radar for BMEWS Site II service. It is thought, however, that the function would be of general interest to others with similar problems of selection under joint operating constraints.
Author

N65-35717# California Inst. of Tech., Pasadena. Antenna Lab.
ANTENNA RADIATION IN A MOVING DISPERSIVE MEDIUM Technical Report No. 34
K. S. H. Lee and C. H. Papas Feb. 1965 22 p refs
(Contract AF 49(638)-1266)
(AFOSR-65-0652; AD-614275)

A solution is presented for solving the idealized problem of calculating antenna radiation when the ambient medium is a homogeneous, spatially unbounded, ionized gas moving at a uniform velocity with respect to the antenna. It is assumed that the antenna is small enough not to disturb the fluid. The differential equation for the potential 4-vector in the rest frame of the oscillating dipole is derived by writing in wave-vector frequency space the conventional inhomogeneous equations for the vector and scalar potentials in the rest frame of the medium. These are then combined to form a single equation for the potential 4-vector. The transformation of this equation

from the rest frame of the medium to the rest frame of the source yields the required equation for the potential 4-vector. The equation is solved by Fourier transform methods. An atomistic approach to the problem is also described, and it is shown that the same results can be obtained as were derived from use of this phenomenological approach. M.G.J.

N65-35719# New Zealand. Dept. of Scientific and Industrial Research, Wellington. Physics and Engineering Lab.
ON VARIATIONS IN THE PHASE VELOCITY OF VERY LOW FREQUENCY SIGNALS OBSERVED IN NEW ZEALAND Final Report
D. D. Crombie, A. H. Allan, and G. J. Burtt 6 Jan. 1965 31 p refs
(Contract AF 64(500)-8)
(AFCRL-65-264; AD-615465)

Observations of changes in the phase delay of VLF signals from GBR, NBA, and NPG have been made in New Zealand. The phase reference signal is provided by Essen ring oscillators of high stability. The observed changes in phase delay due to diurnal variation of path illumination, interference between signals received over both the long and short great circle paths, interference between two or more modes propagating in the same direction, a solar eclipse, and interference between signals propagating simultaneously in the earth–ionosphere waveguide and in magnetoionic whistler ducts are described and discussed. Author

N65-35729# Sylvania Electric Products, Inc., Williamsville, N. Y.
ELECTRONICALLY STEERABLE ARRAY—CHANGE A First Quarterly Technical Report, 30 Nov. 1964–26 Feb. 1965
T. R. Schiller and W. S. Heath Griffiss AFB, N. Y., RADC, May 1965 31 p refs
(Contract AF 30(602)-3041)
(RADC-TR-65-90; AD-617140)

This report describes the effort expended during the first quarter of the Engineering Change "A" portion of the Electronically Steerable Array Program to design and build a high gain, electronically steerable, millimeter antenna system. Design goals for the breadboard model antenna system were formulated during this period, preparations were made for evaluating cubic and hexagonal ferrites for scanning tests and a detailed analysis was made of a proposed hybrid antenna system employing ferrites and a scattering mechanism. The results of this analysis, however, indicate that the hybrid system selected for analysis will not meet all the performance goals of the system so that future design work will be concentrated on ferrite scanner techniques. Author

N65-35731# Syracuse Univ. Research Inst., N. Y.
TRANSIENT AND STEADY-STATE ANTENNA PATTERN CHARACTERISTICS FOR ARBITRARY TIME SIGNALS Tenth Interim Report
Fung-I Tseng and David K. Cheng Griffiss AFB, N. Y., RADC, Jun. 1965 24 p refs
(Contract AF 30(602)-2646)
(EE957-6503T10; RADC-TR-65-101; AD-612034)

This report presents a simplified method for the analytical determination of the transient and steady-state pattern characteristics of an antenna for arbitrary time signals and arbitrary aperture distributions. For uniform aperture illumination, the pattern response of an antenna for any time signal, no matter how complicated, can be found through simple shifts of the signal, and both the transient and the steady-state behavior can be determined without performing any integration. Examples are given for responses to suddenly applied excitations, to rectangular pulses, to excitations for electronic scanning, and to time signals in a pulse-compression system. For pulse signals, a steady state is not reached in any given direction, θ, if the duration of the pulse T is less than $(a/c) \sin \theta$, where a is maximum aperture dimension and c is velocity of light. Graphical representations for easy interpretation of the different state of pattern characteristics are included. Author

N65-35735# Naval Research Lab., Washington, D. C.
EFFECTIVE LENGTHS OF ANTENNAS IN MAGNETO-IONIC MEDIA
William R. Faust 12 Feb. 1965 10 p refs
(NRL-6190; AD-612511)

The voltages induced in dipoles and loop antennas immersed in a magnetoactive plasma are calculated using the Rayleigh-Carson theorem for magnetoactive media. The voltage induced is given in terms of an effective length times the applied electric field, and in the present case the tensor dielectric character of the magneto-ionic medium complicates the effective length calculations. A first approximation for the effective length of a linear dipole in a magnetoactive plasma is derived which can be used if the antenna is short. Because loop antennas are also used in ionospheric propagation experiments, the ratio of the voltage induced in a small loop antenna to that induced in a dipole antenna is derived. Author

N65-35746# Army Electronics Research and Development Activity, Fort Huachuca, Ariz.
SCALE MODEL TECHNIQUES FOR INVESTIGATION OF AIRCRAFT ANTENNA RADIATION PATTERNS Progress Report
Clay O. Stephenson and Luvern R. Bauhs Apr. 1965 44 p ref
(ECOM-6001; USAERDAA-ELCT-12-65; AD-615447)

The initial experimental and theoretical investigation pursued in determining laboratory procedures for pattern measurements of aircraft antennas using scale models in an R.F. anechoic chamber are presented, and analytical techniques of pattern prediction for general antenna-aircraft geometry are developed. The assembling and initial calibration of the automatic instrumentation system has been accomplished. The initial series of investigations consisted of pattern measurements of quarter-wave monopoles mounted on a model of the OV-1 (Mohawk) aircraft. A 1:10 geometric scale factor was used for these tests. The development of a computer program to supplement the radiation measurements is in progress. The initial program employs magnetic and electric field equations to indicate far field vector magnitudes for specified radiator configurations and current distributions on a flat circular ground plane. It is presently being expanded to accommodate air-frame geometry and higher order current element distributions. Author

N65-35753# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WIRELESS POWER TRANSMISSION
Ming-Tau Hua 20 Jan. 1965 10 p Transl. into ENGLISH from K'o Hsueh Ta Chung (China), no. 11, 1963 p 12–13
(FTD-TT-64-795/1+2+3+4; AD-610373)

Radio transmission of electrical power is discussed. Microwave frequencies are necessary for transmission since the beams can be focused to avoid dissipation of energy. Practical applications have not been possible due to difficulties

in developing electronic tubes with adequate power ratings. The use of magnetrons for production of ultrahigh frequency oscillations can eliminate the need for electronic tubes. Power transmission by microwaves through the use of waveguides and relay stations is discussed. J.M.D.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-34733 Joint Publications Research Service, Washington, D. C.

ON SELECTION OF PARAMETERS OF DIGITAL CONTROL MACHINES

A. V. Buldakov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 65–78 ref (See N65-34725 23-34) CFSTI: $6.00

On the basis of the theory of mass servicing [queueing theory] a procedure is proposed for selection of parameters which determine the productivity of a digital computer which is operating under the condition of answers to interrogations. The characteristics of a single channel queueing device are especially investigated. Their analytical expressions are obtained which are more convenient for practical use than those presented in literature. Author

N65-34734 Joint Publications Research Service, Washington, D. C.

ON MONOTONIC ENCODING OF INPUT SIGNALS AND INTERNAL STATES OF AUTOMATA REALIZED IN THRESHOLD ELEMENTS

S. P. Kartasheva *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 79–94 ref (See N65-34725 23-34) CFSTI: $6.00

Encoding of the internal states and input signals of automata is investigated which determines the monotonic excitation function. Necessary and sufficient conditions and the algorithm for this encoding are found. The algorithm for reduction of the non-encoded automata to encoded ones is worked out. Author

N65-34738 Joint Publications Research Service, Washington, D. C.

ON A PROCEDURE FOR MACHINE RECOGNITION OF BINARY NUMBERS

V. Yu.Trakhtman *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 123–133 refs (See N65-34725 23-34) CFSTI: $6.00

A procedure is investigated for recognition of binary numbers which consists in measurement of sums of distances in the observation space. The identity of a recognition device based on this procedure to a simple perceptron is indicated. A procedure is pointed out for design of a perceptron for correct recognition of a training series. Author

N65-34751 Joint Publications Research Service, Washington, D. C.

A PROBABILITY MODEL FOR PROGRAMMED LEARNING

A. M. Dovgyallo *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 275–284 refs (See N65-34725 23-34) CFSTI: $6.00

It is shown that the process for programmed learning may be considered a complex nonhomogeneous discrete Markov chain with an absorption state. Criteria are introduced for quantitative evaluation of the various receivers of the programmed training. A procedure is proposed for selection of the optimal parameters of the learning machines (and programs) which minimize the average number of steps and the average size of the error made by the participants in the course of the program. Author

N65-34766 Joint Publications Research Service, Washington, D. C.

ON TWO RECOGNITION ALGORITHMS FOR PRODUCTION SITUATIONS

Yu. M. Chekhovyy *In its* Automation, No. 1, 1965 2 Sep. 1965 p 121–125 refs (See N65-34753 23-10) CFSTI: $4.00

An attempt is made to decrease the volume of the recognition portion of an automatic control system, that is self-teaching, by using certain differences that can occur in recognition processes. It is shown that an algorithm very frequently used for recognizing images leads to an uneconomical solution in production situations, and that another algorithm is more economical from the point of view of memory volume. L.S.

N65-34879# Massachusetts Inst. of Tech., Cambridge.

SIR: A COMPUTER PROGRAM FOR SEMANTIC INFORMATION RETRIEVAL

Bertram Raphael (Ph.D. Thesis) Jun. 1964 172 p refs
(Contract Nonr-4102(01))
(AD-608499)

SIR is a computer system, programmed in the LISP language, which accepts information and answers questions expressed in a restricted form of English. This system demonstrates what can reasonably be called an ability to "understand" semantic information. SIR's semantic and deductive ability is based on the construction of an internal model, which uses word associations and property lists, for the relational information normally conveyed in conversational statements. A format-matching procedure extracts semantic content from English sentences. If an input sentence is declarative, the system adds appropriate information to the model. If an input sentence is a question, the system searches the model until it either finds the answer or determines why it cannot find the answer. In all cases SIR reports its conclusions. The system has some capacity to recognize exceptions to general rules, resolve certain semantic ambiguities, and modify its model structure in order to save computer memory space. The thesis also describes the formal properties of SIR1 and how they relate to the logical structure of SIR. Author

N65-35139# Los Alamos Scientific Lab., N. Mex.

AN INTEGRATED SERIES OF CRYSTALLOGRAPHIC COMPUTER PROGRAMS. X: ANISOTROPIC STRUCTURE FACTOR CALCULATION AND POWDER PATTERN GENERATION

Allen C. Larson, R. B. Roof, Jr., and Don T. Cromer 29 Sep. 1965 51 p refs
(Contract W-7405-ENG-36)
(LA-3335) CFSTI: $3.00

A program for calculation of structure factors for any space group is described. The program is used in this Laboratory to compute phases for Fourier electron density maps, to compute exact data to test our least-squares program subroutines, and to calculate powder patterns. Author

N65-35194# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
A COMPUTER PROGRAM FOR THE DETAILED DESIGN OF FREE VORTEX TURBINES
R. Wysong and W. Tabakoff Jul. 1965 83 p refs
(TR-651; AD-619079)

A Fortran program written for the detailed design calculations of a free vortex turbine having a maximum of four stages is described. Thermodynamic calculations are based on the use of a constant, average specific heat ratio for each stage. The input to the program consists of data obtained from desired cycle objectives, preliminary sizing calculations and flowpath, thermodynamic properties of the working medium, and certain parameters whose values are left to the designer's judgement and experience. A discussion of pertinent theory, calculation procedures, and general program logic is included. Also included is an explanation of how the program results fit into the overall design of an aircraft gas turbine engine. S.C.W.

N65-35341# Research Analysis Corp., McLean, Va.
EXTENDED USE OF MACRO ASSEMBLERS
Robert A. Magnuson Jul. 1965 85 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-175; AD-470105)

The techniques developed for the use of macro assemblers are discussed. The techniques, while easy enough to learn, are not well known and a literature search has failed to disclose any similar papers by other authors. Programs written using the described techniques have some interesting properties since they are written and debugged in a remarkably short period of time and that they are executed during assembly time. The class of computable functions for which this technique is particularly useful is artificial language implementation. Contained within an important proper subset of this class of problems are data structure generation and the debugging of subroutines and programs, whether conventionally written (i.e., using assembly language, absolute code, fortran, cobol, etc.,) or written using the author's unconventional technique. The coding of the implementation of five artificial languages is contained within this work. These cover a wide variety of situations and all have been run successfully on an IBM 7040 computer. They are explained step by step. By following the coding and explanations the reader may acquire this valuable technique for his own computer usage. Author

N65-35442# Hanford Atomic Products Operation, Richland, Wash.
MINIMIZER: A COMPUTER CODE FOR DETERMINING MINIMUM FUEL COST
E. A. Eschbach, D. E. Deonigi, and A. F. Mc Coniga Jul. 1965 65 p refs
(Contract AT(45-1)-1350)
(HW-71813) CFSTI: $3.00

The MINIMIZER code is an IBM 7090 computer code used in conjunction with other computer codes to estimate the most probable minimum fuel cost from a set of fuel cost data. The determination of a minimum fuel cost is important to selection of overall optimum reactor operating conditions. In addition, deriving the operating point from the minimum fuel cost point provides a consistent basis for evaluating process and economic changes within a given fuel cycle and for comparing fuel cycles using different fuel materials. This report describes the MINIMIZER code and demonstrates its accuracy with various sets of data. Machine printouts of the computer program and of a complete example case are presented in the Appendixes. Author

N65-35494* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO NETWORK REMOTE SITE COMPUTER SYSTEMS
E. Willis *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 181–190 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

A brief description of the 1218 remote site data processor currently being utilized on the Manned Space Flight Network (MSFN) is presented, including brief discussion of the systems configuration and the present capabilities in Gemini missions. New computer systems which are to be installed on all of the Apollo sites are also included. This covers the: a. UNIVAC MOD-642B computer, b. UNIVAC 1540 magnetic tape units, c. UNIVAC 1259 TTY adaptor, d. UNIVAC 2008/10 data transmission units, e. UNIVAC model 1000 CAM adapter and Greenwich mean time (GMT) buffer, f. Motorola TP-4000 3000 word per minute line printer, g. UNIVAC 1299 distribution switchload, and h. Console computer interface adapter. Author

N65-35537# Stanford Univ., Calif. Computer Science Dept.
YIELD-POINT LOAD DETERMINATION BY NONLINEAR PROGRAMMING
Philip G. Hodge, Jr. 18 Jun. 1965 27 p refs
(Contract Nonr-225(37))
(CS25; AD-618215)

The determination of the yield-point load of a perfectly plastic structure can be formulated as a nonlinear programming problem by means of the theorems of limit analysis. This formulation is discussed in general terms and then applied to the problem of a curved beam. Recent results in the theory of nonlinear programming are called upon to solve typical problems for straight and curved beams. The theory of limit analysis enables intermediate answers to be given a physical interpretation in terms of upper and lower bounds on the yield-point load. The paper closes with some indication of how the method may be generalized to more complex problems of plastic yield-point load determination. Author

N65-35545# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
AERIAL RADIOLOGICAL MONITORING SYSTEM. PART III: ELECTRONIC PROCESSING OF ARMS-II DATA
J. E. Hand and H. M. Borella Oak Ridge, Tenn., AEC, Dec. 1962 70 p refs
(CEX-59.4) CFSTI: $1.00

A method of utilizing electronic data processing techniques for the reduction and presentation of airborne terrestrial radiation measurements is presented. A nominal-sized area entails some 10,000 traverse miles of flying with the acquisition of nearly 100,000 data points. As a consequence, manual reduction and presentation of the raw data are highly impractical. For rapid reduction and early availability of the data, it is necessary that modern electronic techniques be adapted to the processing of ARMS-II data. The system described utilizes the IBM-704 electronic computer as the principal processing machine. Peripheral gear includes the following IBM equipment: 1401 computer, 407 lister, 047 tape-to-card converter, 523 summary punch, and 082 card sorter. Data are recorded in flight as binary entries onto punched tape. The data on the field tapes and the ground measurements necessary for computation are sent to the ARMS-II laboratory and converted to IBM card formats for entry into the computer. The data are taken to the computer center and processed; the computer provides the output information as a decimal tabulation of the radiation levels and their associated geocentric coordinates

and converts the data to coordinates that are compatible with the X–Y plotter input requirements. The data positions and radiation levels are plotted as map overlays at 1 mile per inch scale, from which the final presentation form is prepared. Author

N65-35585# European Space Vehicle Launcher Development Organization, Paris (France).
NOTE ON APPLICATION OF PERT TECHNIQUE TO THE ELDO PROGRAMMES
R. Orye Aug. 1965 23 p
(ELDO-TM-P2) CFSTI: HC $1.00/MF $0.50

A memorandum designed for use as a manual for the application of the PERT (Program Evaluation and Review) technique to the ELDO (European Launcher Development Organization) programmes, is reported. Included is a description of the practical rules for network preparation and program reporting. S.C.W.

N65-35592# Mitre Corp., Bedford, Mass.
MASKED SEARCH PROGRAM
G. S. Stoller Jan. 1965 29 p
(Contract AF 19(628)-2390)
(W-06614; ESD-TDR-64-629; AD-610062)

The Masked Search Program is a static trace and can be used for debugging or modifying 7090 program. This report describes the program and how it is used in most cases. Additional information is provided to cover unusual occurrences during the program run. Author

N65-35597# Pennsylvania Univ., Philadelphia.
INTERACTIONS OF COMPUTER LANGUAGE AND MACHINE DESIGN Final Report
H. J. Gray, C. Kapps, W. C. Slemmer, and A. L. Vivatson Griffiss AFB, N. Y., RADC, May 1965 288 p refs
(Contract AF 30(602)-2994)
(RADC-TR-64-511; AD-617616)

The feasibility of the design of a computer that can interpret any programming language; that adds items to the programming language which make the language more useful; that uses a specified multi-list procedure; that uses a form of associative memory that can be replaced without any modification to the rest of the computer by another form of associative memory; and that can compile and compute programs written in the programming language was determined. The investigation specifies optimum memory size, register size, and interface logic to be used in constructing the multi-list organized machine. The practicality of designing a machine with an internal design capability of interpreting any language as input is refuted. L.S.

N65-35767# Aerospace Corp., Patrick AFB, Fla. Eastern Test Range Office.
GEMINI QLAP REQUIREMENTS—PART II
M. L. Schauerman 16 Apr. 1965 160 p
(Contract AF 04(695)-469)
(TOR-469(A5126-10)-2, Vol. I; AD-603551)

Data on the requirements of the Gemini QLAP (Quick Look Analysis Program) are reported. The program will be used to process formated PCM data tapes in conjunction with other source data to provide an early source of performance information for the vehicle's propulsion, guidance, control, electrical and structural systems, and the vehicle's aerodynamic environment and external tracking systems. Presented is a detailed description of program input information and the computer program. S.C.W.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-34761 Joint Publications Research Service, Washington, D. C.
THE SUPPLYING OF ACTUATING LINKS OF A QUICK-ACTING PRINTING DEVICE FROM THE AC NET
A. D. Bolychevtsev *In its* Automation, No. 1, 1965 2 Sep. 1965 p 83–91 refs (See N65-34753 23-10) CFSTI: $4.00

The operating principle of a quick-acting electromagnetic printing device using continuously turning numerical wheels is explained, and a diagram of the device is depicted. A proposal is presented which would supply the actuating links with alternating or pulsating current allowing essential increases in the reliability of the device. A schematic diagram of such an actuating link is also depicted. A mathematical analysis of the circuit operation was conducted, and calculations indicate that expressions for printing speed remain valid. It is noted that several printing devices of this type have been constructed and tested. The devices are much more reliable in operation, simpler in servicing, and more economical for equipping than comparable printing devices for which the actuating links are supplied with DC current. L.S.

N65-34773# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
ELECTRONIC EQUIPMENT INTERFERENCE CHARACTERISTICS—COMMUNICATION TYPE Quarterly Report No. 8, 15 Jan.–15 Apr. 1965
William R. Free and Charles W. Stuckey [1965] 78 p refs
(Contract DA-36-039-AMC-02294(E))
(Rept.-29; AD-618722)

During the period covered by this report, investigations to extend the determination of the interference characteristics of U. S. Army communication equipment to include the near-field emission and susceptibility characteristics have continued. Two techniques, the Hooded Antenna Technique and a Paraboloidal-Section Shaped Enclosure, show considerable promise as a means of obtaining the desired controlled environment. Descriptions and evaluations of these techniques are discussed in detail. A model of a conventional shielded enclosure was evaluated in considerable detail to provide a reference for evaluating the hooded antenna technique and the paraboloidal-section enclosure. The model enclosure was also utilized to evaluate absorbing materials and the placement of absorbing materials in a conventional shielded enclosure. A description of the antenna coupling technique utilized in these evaluations, as well as the data resulting from these evaluations are discussed. Author

N65-34782# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 216
13 Sep. 1965 40 p refs Transl. into ENGLISH of selected articles from Tien-tzu Chi-shu (Shanghai), no. 12, 1964 (JPRS-31970; TT-65-32464) CFSTI: $2.00

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1. TUNNEL EMISSIVE THIN-FILM TRIODES C.-H. Ch'en p 1–11 refs (See N65-34783 23-09)
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3. TECHNIQUES AND APPLICATION OF THE OXIDATION OF SEMICONDUCTOR ANODES Y. Kang and H.-L. Li p 20–26 refs (See N65-34785 23-09)

N65-34783 Joint Publications Research Service, Washington, D. C.

TUNNEL EMISSIVE THIN-FILM TRIODES

Ch'i-hsiang Ch'en *In its* Transl. on Communist China's Sci. and Technol. No. 216 13 Sep. 1965 11 p refs (See N65-34782 23-09) CFSTI: $2.00

The fundamental theory and structure of thin-film circuits and the phenomenon of tunnel emission in extremely thin dielectric films, are discussed. When no external voltage is applied to the gap between two metals, the number of electrons crossing from one metal to the other via the tunnel effect will equal the number of electrons crossing from the opposite direction, thus resulting in a total current of zero. Introduction of voltage between the two metals changes the energy state, the probability of electrons crossing from the cathode metal will be higher than those crossing from the anode, and the phenomenon of tunnel emission develops. This principle works in thin film triodes consisting of three layers of metallic aluminum film that are separated by two layers of dielectric thin films. The characteristic curves of the emitting and collecting electrodes of thin-film triodes are similar to those of the crystal triodes. G.G.

N65-34784 Joint Publications Research Service, Washington, D. C.

FUNDAMENTAL REQUIREMENTS OF TRANSISTOR TUBE RECEIVER CHARACTERISTICS

Tso Yen *In its* Transl. on Communist China's Sci. and Technol. No. 216 13 Sep. 1965 p 12–19 (See N65-34782 23-09) CFSTI: $2.00

Superheterodyne transistor receivers are classified according to application and characteristics. Generally, types with a volume exceeding 5,000 cm^3 are consoles; between 1,000 and 5,000 cm^3 are portables; and under 1,000 cm^3 are pocket, and sub-miniature transistors. All are able to operate in various frequency ranges and have a normal signal-noise ratio of not smaller than 20 db when the output load has one-tenth the rated output power. Selectivity for a conventional receiver is higher than 15 to 20 db. Brief discussions of transistor selectivity, attenuation coefficients of intermediate frequency waves and of image frequencies, output power, synchronous responses, and the control of mechanical vibrations are included. G.G.

N65-34785 Joint Publications Research Service, Washington, D. C.

TECHNIQUES AND APPLICATION OF THE OXIDATION OF SEMICONDUCTOR ANODES

Yuan Kang and Hsiao-ling Li *In its* Transl. on Communist China's Sci. and Technol. No. 216 13 Sep. 1965 p 20–26 refs (See N65-34782 23-09) CFSTI: $2.00

Discussed is the use of an immersed semiconductor as oxidation anode and the subsequent chemical decomposition of the obtained oxidation layer to a desired thickness. This layer removal technique has the following advantages: (1) it ensures absolute uniformity of the thin layer being removed; (2) the removed layer can be controlled to 400 Å, and in some cases to even a few tens of angstroms; and (3) the anode surface is not destroyed during the removal of layers. An example of silicon dioxide layer removal from a silica semiconductor is given. G.G.

N65-34859# General Electric Co., Syracuse, N. Y. Electronics Lab.

INVESTIGATION OF FERRITE PHASE-SHIFTERS AT C- AND X-BAND Final Report, 1 Jul. 1964–30 Jun. 1965

Robert Seckelmann Jul. 1965 173 p refs
(Contract AF 30(602)-3482; ARPA Order 550; Proj. Defender) (AD-618738)

The phase shifters discussed are nonreciprocal. They contain circumferentially magnetized ferrite cylinders, which work at remanence. The differential phase shift is controlled by partial magnetization of the ferrite, achieved by controlled flux transfer. Three problems, common to all such phase shifters are dealt with: (1) The efficiency of flux transfer and the possibility to add flux bits was investigated. Experimental data and a theory in agreement with these data are presented. (2) Magnetic threshold fields above which the losses of ferrites increase with field strength were determined. The threshold was calculated from the measured threshold power of guides completely or in part filled with ferrite. (3) The influence of waveguide and ferrite dimensions on the frequency dependence of the differential phase shift, on the proportionality between phase shift and transferred flux, and on the peak power handling capability was investigated experimentally. Slabline and waveguide type devices were used. Author

N65-34860# IIT Research Inst., Chicago, Ill.

ELECTRONIC EQUIPMENT CHARACTERISTICS: RADAR TYPES , Final Report, 15 Feb. 1964–15 Apr. 1965

B. Ebstein, J. J. Krstansky, P. Mc Manamon, I. N. Mindel, R. D. Standley et al. [1965] 279 p refs
(Contract DA-28-043-AMC-00004(E)) (Rept.-4; AD-619087)

The objectives of this program were to establish measurement procedures for defining interference characteristics of radar equipment. Studies of the M33 acquisition radar antenna characteristics at out-of-band frequencies were conducted. Multimode instrumentation including sixteen mode launchers, mode filters, and a multimode pad were developed. Analysis of ground proximity effects on antenna pattern measurement techniques was conducted. A method of obtaining far-field patterns from a special near zone antenna range was briefly investigated. Experiments were conducted on single mode and multimode systems to establish the validity of the pattern integration technique as a method of measuring transmitter emission spectrum. Author

N65-34861# Pacific Missile Range, Point Mugu, Calif.

DISCUSSION OF DROPOUT CRITERIA FOR MAGNETIC TAPE

R. J. Roanhaus 4 Aug. 1965 12 p
(PMR-TN-65-2; AD-619025)

An investigation was conducted to determine the nature and cause of magnetic tape "dropouts" (short-duration decreases in signal amplitude) and their effect on analog data. Results of the tests indicated that more realistic dropout standards should be adopted for recertified tape used for analog recording. It was determined that the largest single cause of dropouts is the presence of foreign material adhering to the oxide surface

of the tape. It is recommended that the dropout standards for re-certified analog tape be established at 18 db in depth and 100 microseconds in width. The tape should be thoroughly cleaned before it is checked for dropout content. Author

N65-34862# Microwave Electronics Corp., Palo Alto, Calif.
DEVELOPMENT OF TWO X-BAND VARIABLE GAIN TWTs (ONE LOW LEVEL AND ONE MEDIUM LEVEL) Interim Development Report, 1 Jan.–31 Mar. 1965
Norman Berger, G. A. Foggiato, and J. Gaenzle Jul. 1965 81 p refs
(Contract NObsr-91341)
(IDR-3; AD-619274)

Four tubes were fabricated and tested for small signal gain, noise figure and power output during this reporting period. The large gap between performance obtained and that specified emphasizes the need for a more analytical approach to the problem. Theoretical analysis has been made of the effect of helix dispersion on attaining flat, wide-range (30 db) gain control. The cases of positive and negative dispersion are presented to derive the relative merit of tubes fabricated with helices with these dispersions. An analysis of output power versus center-helix voltage (three-helix TWT) has been made and correlation of data from a fabricated tube is attempted. Of special interest is the output-helix gain required to maintain constant power output and different gain levels. A short analysis of noise figure is made but further study must be pursued in this direction. Author

N65-34894# Holman (John F.) and Co., Inc., Washington, D. C.
THE INVESTIGATION OF THE ELECTRO-MECHANICAL TRANSIENT PROCESSES IN FREQUENCY-CONTROLLED SYNCHRONOUS, REACTION-TYPE ELECTRIC MOTORS BY MEANS OF ELECTRONIC SIMULATION DEVICES [ISSLEDOVANIYE ELEKTROMEKHANICHESKIKH PEREKHODNYKH PROTSESSOV CHASTOTNO-UPRAVLYAYEMYKH SINKHRONNO-REAKTIVNYKH DVIGATELEY S POMOSHCH'YU ELEKTRONNYKH MODELIRUYUSHCHIKH USTANOVOK]
B. A. Yegorov Aug. 1965 17 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Elektromekhan. (Novocherkassk), no. 7, 1964 p 848–857
(Contract DA-44-009-AMC-930(T))
(T-1796-65; AD-618739)

In investigating the dyanmic states of synchronous reaction-type motors, it was assumed that the static and dynamic mechanical characteristics of the motor are identical; criteria for making these assumptions are included. Saturation, core losses, and the higher harmonics of the magnetic field are ignored; and voltage and frequency variations at the stator terminals are assumed to follow a known law. Equations are given, and the results obtained in solving them by means of an electronic simulator were compared with the results obtained by investigating the transient states on a prototype. Comparison showed the acceptability and accuracy of the proposed method. M.G.J.

N65-34898# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF SOLID STATE DISPLAY CONTROL CIRCUITRY
James Richard Wade (M.S. Thesis) Jun. 1965 75 p refs
(GGC/EE/65-17; AD-618685)

Electroluminescent phosphors and lamps have advanced during recent months to the point that usable electro-luminescent displays are now practical. However, there exists a considerable gap in between the technology of displays and that of the necessary solid state control circuitry. This work is an attempt to develop such control circuitry. The various advantages and disadvantages of ferro-electric elements, photoconductors, and silicon controlled rectifiers are analyzed. Silicon controlled rectifers are selected as primary control elements, and control circuits are developed for bar graph and pointer displays. The pointer display uses SCR controlled variable voltage dividers and provides for the control of several lamp segments by a single control element. Author

N65-34956* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPERATION OF THE MARK 1 X-RAY TUBE AT ELEVATED TEMPERATURES
N. Nickle *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 45–47 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The miniaturized X-ray tube was allowed to overheat during operation in order to determine the maximum operating-temperature limit when the tube is integrated with the lunar X-ray diffractometer. Changes in the peak parameters of the quartz (101) reflection was used as an indication of tube failure. The parameters were measured at 10° C temperature intervals from 60° to 205° C, after thermal equilibrium had been established at each interval. The tube survived 90 hr of operation at temperatures greater than those experienced during normal laboratory operation and 7 hr at temperatures exceeding 200° C. The upper operating temperature limit for the tube is not known. If the tube were subjected to sufficient temperatures for failure, it is considered that other parts of the diffractometer would fail first. It is significant that no change in the peak parameters was noted when part of the goniometer casting was heated. This indicated little or no warping of the goniometer. E.E.B.

N65-34985# Naval Ordnance Lab., White Oak, Md. Physics Research Dept.
DELAY LINE TIME COMPRESSOR WOX-3A
John C. Munson and Lester E. Barton Jun. 1964 50 p refs (NOLTR-61-47; AD-601618) CFSTI: $1.50

The 10 megacycle bit rate digital transistorized circulating memory, commonly called a DELTIC, is discussed. A short description of basic principles is given and the details of circuit operation are briefly treated. Block diagrams, schematics, and photographs showing component layouts are included. Photographs are shown of typical waveforms at various points within the system, and these are keyed to the block diagrams and schematics. C.T.C.

N65-35009# Commissariat a l'Energie Atomique, Grenoble (France). Centre D'Etudes Nucleaires.
DEVELOPMENT OF A NEW TIME-AMPLITUDE CONVERTOR WITH TUNNEL DIODES FOR IMPROVING FAST NEUTRON SPECTROMETRY BY TIME OF FLIGHT [REALISATION D'UN NOUVEAU CONVERTISSEUR TEMPS-AMPLITUDE A DIODES "TUNNEL" AMELIORANT LA SPECTROMETRIE DES NEUTRONS RAPIDES PAR TEMPS-DE-VOL]
R. Van Zurk (Ph.D. Thesis) 1964 42 p refs In FRENCH; ENGLISH summary
(CEA-R-2405) CFSTI: HC $2.00/MF $0.50

New time-amplitude convertor with Esaki diodes, the events being pre-selected before analysis, allows for realizing a fast neutron spectometer by time-of-flight with an $1.5 \cdot 10^{-9}$ s overall time resolution for $^{12}C(n,n')$ at 14 MeV. Author

N65-35038# New York Univ., N. Y. Lab. for Electroscience Research.
A CLASS OF ZERO SENSITIVITY AMPLIFIERS Sixteenth Scientific Report
John Golembeski Apr. 1965 64 p refs *Its* Tech. Rept.-400-109
(Contract AF 19(628)-379)
(AFCRL-65-359; AD-619418)

A class of amplifiers is presented which has the feature that the amplifier gain sensitivity to differential changes in the gain of the active devices can be made zero. The effect of large changes in the device gain is also studied and incorporated in the design procedure. Two methods of exploiting this capability are considered. The first provides for the design of an amplifier based on a pole-zero configuration, and permits the optimization of the gain sensitivity in the passband. The second approach is oriented to take advantage of its usefulness in microelectronic linear amplifiers. It is shown that redundancy can be utilized, so that a useful amplifier can be designed with a-priori knowledge that some of the active devices will be inoperative and that others will have a wide range of characteristics. This feature makes the configuration well suited for microelectronic applications, where a large number of nominally identical units can be fabricated economically, although some fraction of the total will be inoperative. Author

N65-35081# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR COLUMBIUM CAPACITORS Concluding Quarterly Report, 26 Sep. 1964–26 Mar. 1965
J. H. D. Folster, E. E. Holley, and A. Whitman [1964] 24 p
(Contract DA-36-039-AMC-01468(E))
(AD-618055)

The inspection and life testing of the ratings required for the preproduction run were completed. The results of these tests indicate that columbium cannot be used as a direct replacement for tantalum in electrolytic capacitors. It is concluded that the basic characteristics and limitations of columbium are such that the contract objectives are beyond the capability of the material. Author

N65-35091# General Electric Co., Auburn, N. Y. Semiconductor Products Dept.
THE DEVELOPMENT AND EVALUATION OF A BILATERAL TRIODE SWITCH Quarterly Progress Report, 13 Apr.–13 Jul. 1965
[1965] 37 p refs
(Contract NObsr-91151)
(QPR-5; AD-619050)

This quarterly report describes the work performed toward the development of an improved bilateral triode p-n-p-n switch. Device assembly methods are discussed, and the reasoning is given leading to the present design. Several important features of the advance final design are presented, especially those bearing on the dynamic properties of the device. Photoresist techniques as employed on this device are discussed. Author

N65-35097# Hewlett-Packard Co., Palo Alto, Calif.
MICROWAVE SWEPT-FREQUENCY MEASUREMENTS Application Note No. 65
Aug. 1965 44 p refs

Attenuation, impedance, power, and frequency are discussed in relation to swept frequency techniques. The basic concepts of signal generation, detection, and readout, which are common to all swept measurement systems, are considered. A summary of leveled systems includes data and instructions for crystal leveling in coax and waveguide, power meter leveling, and one-watt level sources. Recently developed systems and techniques are described to provide continuous broadband displays of microwave performance and to eliminate or reduce errors in measurements. The section on attenuation covers measurements in waveguide and coax as well as directivity measurements. Waveguide and coax measurements are also considered under impedance; as are X–Y recording reflection tests, RF pre-insertion—X–Y recorder technique, and special techniques. Thermistor mount efficiency testing, TWT amplifier gain test, and high resolution attenuation tests are reviewed. A discussion of frequency deals with wavemeter calibration, system accuracy, and cavity Q measurements. A noise figure is shown for the analysis of devices such as TWT amplifiers. M.W.R.

N65-35117*# General Electric Co., Syracuse, N. Y. Electronics Lab.
DESIGN AND DEVELOPMENT OF SOLID STATE IMAGE CONVERTER FOR SPACE VEHICLES Final Report, 1 Jun. 1963–30 Apr. 1965
R. E. Glusick, K. W. Laendle, D. C. Osborn, R. C. Roberts, and R. D. Stewart Apr. 1965 206 p refs
(Contract NAS8-5116)
(NASA-CR-67263) CFSTI: HC $6.00/MF $1.25 CSCL 09C

In refining the overall solid state image converter system to conform with device fabrication requirements, the image sensing technique was modified, and the scanning system was implemented for incorporation into the design concept. The circuit and system analyses of the image sensor matrix are described, along with two schemes developed to drive and scan the matrix. These are: tapped piezoelectric ceramic delay lines, with intersecting acoustic waves on a continuous ceramic sheet; and solid state microelectronic components for obtaining driving and timing voltages. The relative advantages of this latter method are pointed out. The materials used, and device fabrication methods employed to achieve a 30 × 30 integrated structure at a density of 50 lines per inch are also detailed. Results indicate a potentially successful image converter matrix, at a reduced resolution capability from the specified 600 to 800 lines. Limitations of the design goals and areas of required development are delineated. A report on previous phases of the study is appended. M.G.J.

N65-35146# General Instrument Corp., Darlington, S. C. Capacitor Div.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID TANTALUM CAPACITORS Quarterly Report, Dec. 29, 1964–Mar. 28, 1965
Floyd R. Banks, Jr. and A. Di Giacomo [1965] 24 p
(Contract DA-36-039-AMC-03622(E))
(QR-7; AD-619081)

Process improvement studies were conducted primarily on the 100 MFD-20 Volt capacitor; some of these studies were applied to the 33 MFD-35 Volt capacitor rating. The areas of process improvement studies were: (a) tantalum powder control and anode design; (b) binder control; (c) sintering; (d) anodizing and re-forming; and (e) ageing and screening. Results are summarized and the technical conclusions derived are listed. Author

N65-35208*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF SIMULATED SPACE PARTICULATE RADIATION EFFECTS OF MICROELECTRONICS
Emanual Rind and Floyd R. Bryant [1964] 16 p refs Presented at the 1964 IEEE Intern. Conv., New York, 23–26 Mar. 1964
(NASA-TM-X-54525) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Mircoelectrons are adversely affected by radiation environments. Space radiation environments are briefly summarized. Proton irradiation data at 22, 40, 128, and 440 Mev are presented for typical macroelectronic components such as low-, medium-, and high-frequency transistors and compared with similarly irradiated discrete- and integrated-circuit type of microcomponents. Damage tends to vary inversely with energy. Integrated flux levels of approximately 10^{11} protons/cm^2 are needed before the radiation effects become noticeable. Integrated circuits appear to be slightly more resistant to radiation but this finding may not be significant on a statistical basis. A typical experimental setup and circuit which were actually used in the tests are illustrated and described. Author

N65-35214*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A DATA STORAGE SYSTEM FOR OBTAINING MISSILE REENTRY HEATING DATA
Thomas B. Ballard [1964] 13 p Presented at the 1964 IEEE Intern. Conv., New York, 23–26 Mar. 1964
(NASA-TM-X-54626) CFSTI: HC $1.00/MF $0.50 CSCL 09C

A miniature data storage system used to obtain missile reentry heating data is described. The system does not employ a radio link. Instead, digital information is stored in a 360-bit nondestructive readout ferrite memory which is interrogated after recovery of the instrument package. The stored digital information is a series of times at which predetermined nose-gap temperatures were reached. Author

N65-35241*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT DEVELOPMENTS IN SEMICONDUCTOR CIRCUITS
John C. Sturman Washington, NASA, 1964 20 p Presented at the Conf. on Ind. Appl. of New Technol. by AEC and NASA, Atlanta, 2–3 Apr. 1964
(NASA-TM-X-52013) CFSTI: HC $1.00/MF $0.50 CSCL 09A

New developments in semiconductor circuits for general industrial use and space vehicle applications are presented. A general class of digital logic circuits designed for the lowest possible power consumption at a relatively low operating speed is discussed. Their performance is well suited to these operating conditions but is not limited to them. Operation at high power levels and high speed is feasible and the circuits possess many desirable features such as nearly ideal waveforms and efficiency independent of the power level for which they were designed. The basic operation of the low power circuits and the features that recommend them for industrial and computer type applications are described. R.N.A.

N65-35256*# Stanford Univ., Calif. Dept. of Physics.
DIRECT MEASUREMENT OF XENON FLASHTUBE OPACITY
J. L. Emmett, A. L. Schawlow, and E. h. H. Weinberg (ONR, San Francisco) [1964] 21 p refs Submitted for Publication
(Grant NsG-331)
(NASA-CR-56917) CFSTI: HC $1.00/MF $0.50 CSCL 09A

The optical transmission of a xenon flashtube has been measured at wavelengths from 2500 Å to 10000 Å and at currents up to 5000 amperes per cm^2. It is found that the absorption increases with current and with wavelength. Above about 5000 Å and a current of 4000 amperes per cm^2, a discharge tube 1 cm thick is nearly opaque. At shorter wavelengths or lower currents, the discharge is fairly transparent. Author

N65-35338# Oak Ridge National Lab., Tenn.
ABSOLUTE ENERGY CALIBRATION OF SOLID STATE DETECTORS FOR FISSION FRAGMENTS AND HEAVY IONS
H. W. Schmitt, W. M. Gibson, J. H. Neiler, F. J. Walter, and T. D. Thomas [1965] 12 p refs
(Contract W-7405-ENG-26)
(RNL-P-1089; CONF-650301-11)

The response of a wide variety of silicon semiconductor detectors to fission fragments and to monoenergetic fission fragments was studied to obtain calibration information to allow precise particle energies to be obtained from pulse-height measurements and to obtain new information on the charge production process and on conduction processes in silicon diodes at very high ionization densities. Only the calibration of solid state detectors is discussed in detail. Detector response and the mass dependence of the pulse height defect are considered. E.E.B.

N65-35431# General Electric Co., Auburn, N. Y. Semiconductor Products Dept.
RESEARCH AND DEVELOPMENT OF SILICON CONTROLLED RECTIFIERS FOR HIGH FREQUENCY AMPLIFIER APPLICATIONS Quarterly Progress Report, 16 Apr.–16 Jul. 1965
[1965] 38 p
(Contract NObsr-91299)
(QPR-3; AD-619049)

The approach to the problem of obtaining the specified dv/dt characteristics of the device is discussed, followed by a description of the present fabrication process. Electrical operating test data on laboratory devices are presented, and the specialized test equipment is described. Author

N65-35433# Sprague Electric Co., North Adams, Mass.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID ELECTROLYTE TANTALUM CAPACITORS Quarterly Report, 29 Dec. 1964–29 Mar. 1965
J. M. Eckfeldt and J. H. D. Folster [1965] 24 p
(Contract DA-36-039-AMC-03621(E))
(QR-7; AD-618719)

The production run of capacitors of nine different ratings was begun during this period, and the construction of test fixtures for life testing these capacitors was finished. Evaluation of all the mechanized assembly equipments was completed during this period. All seven mechanisms have been employed in the production run. Matrix testing during this period confirmed the value of a new high-temperature silver paste and the benefits of machine-soldering the capacitors and covers to the cases. Author

N65-35466# Weapons Research Establishment (Australia).
THE CHARACTERISTIC IMPEDANCE AND VELOCITY RATIO OF DIELECTRIC SUPPORTED STRIPLINE
H. E. Green and J. R. Pyle Jun. 1964 12 p refs
(WRE-TN-PAD-90) CFSTI: HC $1.00/MF $0.50

This paper presents theoretical results for the characteristic impedance and velocity ratio of dielectric supported stripline which have been obtained by numerical methods using an IBM 7090 digital computer. A theoretical estimate of accuracy is included. An account is also given of complimentary experimental work which agrees to high accuracy with the theoretical solutions. Author

N65-35519*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CENTAUR ELECTRICAL SYSTEM PROBLEMS, RELATED WORK, AND SOLUTIONS
Maurice F. Baddour Washington, NASA, 1965 16 p
(NASA-TM-X-52105) CFSTI: HC $1.00/MF $0.50 CSCL 09C

Atlas Centaur electrical equipment problems and their solutions are summarized. Problems with the two silver-zinc 100-ampere-hour batteries are cited. The procedures by which the static inverter was removed from the critical list and made reliable enough to be flight qualified are described. J.M.D.

N65-35539# Sandia Corp., Albuquerque, N. Mex.
A LOW-NOISE, LOW-FREQUENCY AMPLIFIER
D. L. Caskey Feb. 1965 5 p
(Contract AT(29-1)-789)
(SC-TM-65-84)

A low-noise, low-frequency amplifier is described. The amplifier has a gain of 500 over the frequency range 0.2 cps to 10 kc, while the noise voltage referred to the input is approximately 15 microvolts. The unit operates in a temperature environment of −25 to +125° F. Author

N65-35559# Chalmers Univ. of Technology, Goteborg (Sweden). Research Lab. of Electronics.
ANOMALOUS NOISE PEAK IN ADLER TUBES
Olle Nilsson 1965 17 p refs *Its* Res. Rept.-51
(Contract AF 61(052)-594)
(RADC-TR-65-322; AD-619059)

An experimental investigation of the noise stripping mechanism in two Adler tubes with high residual gas pressure ($> 10^{-6}$ mm Hg) has revealed the presence of an anomalous noise peak (> 1 000° K). The peak occurs at a frequency somewhat lower than the cyclotron frequency. It is proposed that the peak is produced by elastically scattered beam electrons traveling slowly through the input coupler. The phenomenon is described in terms of an idealized theory which is in good agreement with the experimental findings. Author

N65-35565# Lincoln Lab., Mass. Inst. of Tech., Lexington.
FRINGING CAPACITANCES FOR OFFSET COUPLED STRIPS IN SHIELDED STRIP LINE
William J. Getsinger 1 Jul. 1965 9 p ref *Its* Tech. Note No. 1965-33
(Contract AF 19(628)-5167)
(ESD-TDR-65-273; AD-618927)

Even- and odd-mode fringing capacitances are presented for a widely used strip-line configuration that consists of two overlapping thin strips parallel to but not centered between ground planes. All the fringing capacitances are presented in terms of a single function, which is plotted for convenience. Author

N65-35584# Oak Ridge National Lab., Tenn.
NON-INTEGRATING STRETCHER FOR PULSES OF 20 mV TO 2.5 V HEIGHT AND 6 TO 300 ns DURATION
Christian Weddigen [1964] 12 p Transl. into ENGLISH of Rept. KFK-247, Kernforschungszentrum, Karlsruhe, West Germany, Sep. 1964
(ORNL-TR-513)

Described is a fast nonintegrating pulse stretcher with small dead time which was developed for 6 to 300 ns and 0.02 to 2.5-V negative input pulses. The pulse stretcher serves to show spectra of fast pulses with the use of commercial multichannel analyzers, the analog-to-digital converter of which requires pulse durations of about 1 μsec. Presented are data on the circuitry, mechanical construction and switching elements, and results of tests on pulse shapes: trigger behavior, linearity, and temperature stability. S.C.W.

N65-35596# Rome Univ. (Italy). Istituto di Elettronica.
MODES IN WAVEGUIDES FILLED WITH LONGITUDINALLY MAGNETIZED FERRITE Interim Scientific Report No. 1
Georgio Gerosa 28 Apr. 1965 4 p refs
(Contract AF 61(052)-807)
(AFCRL-65-390; AD-617742)

Algebraic errors in a paper on ferrite filled waveguides are identified. The previously published paper, entitled *Isoform Modes in a Ferrite Filled Waveguide*, by LI. G. Chambers, concerned the possibility of expressing the transverse components of the electric and magnetic fields in terms of the longitudinal components. It is shown that this possibility does not exist. J.M.D.

N65-35639# Raytheon Co., Waltham, Mass. Research Div.
STUDY OF MICROWAVE GENERATION BY MEANS OF ELECTRON BEAM INTERACTION WITH ANISOTROPIC MEDIA Final Report, 1 Jul. 1963–31 Jan. 1965
S. F. Paik, R. J. Briggs, and J. M. Osepchuk [1965] 175 p refs *Its* Rept.-6
(Contract DA-36-039-AMC-02362(E))
(S-747; AD-615555)

The possibility of generating a microwave signal by means of an interaction between electron streams and various anisotropic media is investigated. In particular, properties of microwave slow-wave systems made of plasmas and pyrolytic graphites are studied to determine the feasibility of utilizing such slow-wave systems as "circuits" in beam-type microwave oscillators. Results of an experimental study on the surface-wave mode (backward-wave) of propagation in annular plasma columns is presented. The attenuation of the wave is observed to increase rapidly when a small magnetic field in the axial direction is applied. This enhanced attenuation can not be explained on the basis of the usual collision theory. A theory of "resonance absorption" mechanism which occurs as a result of a gross density inhomogeneity is presented as a possible explanation for the enhanced attenuation observed. The results of this theoretical study is applied to give "plausible" explanation for some of the known results of related experiments. Author

N65-35643# Microwave Associates, Inc., Burlington, Mass.
BROADBAND MICROWAVE POWER LIMITERS Final Report, 21 Jun. 1963–31 Jan. 1965
L. Nathanson [1965] 110 p refs
(Contract NObsr-89462)
(AD-615123)

This report contains results secured during the entire period of this contract, from June 1963 through January 1965. Theoretical aspects are included pertaining to diode characteristics and behavior, and diode limiter design including low-pass filter design, quarter-wave transformer theory, and varactor and feedback limiter configurations. The high power considerations presented refer to both optimum circuit considerations and to diode temperature response. Also presented are the final design information and final experimental results of the L/S-band (1–4.5 Gc/s), C-band (4–7.5 Gc/s), and X-band (7–11 Gc/s) high and low power limiters. Author

N65-35644# Michigan Univ., Ann Arbor.
INVESTIGATION OF LARGE-SIGNAL KLYSTRON AND TRAVELING-WAVE DEVICES Quarterly Progress Report No. 1, 1 Sep.–30 Nov. 1964
G. T. Konrad and J. E. Rowe Griffiss AFB, N. Y., RADC, Mar. 1965 54 p
(Contract AF 30(602)-3569)
(RADC-TR-64-585; AD-615150)

A general nonlinear two-dimensional interaction theory is employed to analyze Brillouin flow in the presence of large-signal r-f on the circuit. Finite values of axial magnetic field and radial variations of both the circuit and space-charge fields are assumed. The present status of the nonlinear boundary-value problem solution for electron and plasma devices is described. The computer program is ready for checkout. Considerations in the initiation of two experimental programs are described. One is a study of beam stability in the presence of large r-f fields, while the second deals with velocity distribution effects on the start-oscillation conditions of BWO's. Results of cold tests made on several ring-and-bar circuits are summarized. Calculations on a phase-focused ring-and-bar tube are initiated. Two digital computer programs for the solution of electron guns are being worked on. The first deals with magnetron injection guns and is shown not to be reliable as yet. The second one is concerned with relativistic electron beams. This program is ready for checkout. Author

N65-35645# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
STUDY OF FABRICATION MICROELECTRONIC ASSEMBLIES FOR FREQUENCY AND TIME CONTROL SYSTEMS. PHASE II: A FEASIBILITY MODEL OF A MICROMINIATURE VLF/LF FREQUENCY SYNTHESIZER Final Development Report, 1 Apr. 1964–5 Apr. 1965
J. W. Mc Lucas and K. M. Peterson [1965] 79 p
(Contract NObsr-87593)
(MDE-5082; AD-615413)

The purpose of phase II of this contract was to design and fabricate a VLF/LF frequency synthesizer in microelectronic form. The circuits utilized were developed specifically for this purpose under phase one of the contract. The synthesizer is packaged in pluggable modules for easy maintenance. It covers the frequency range from 100 cps to 1 mc, at 100 cps increments and will switch frequencies in 20 microseconds. The ambient temperature range is 0° C to 50° C; the power consumption is 10 watts. Compared to similar equipment it has 1/3 the components, is 1/40 the size, consumes 1/4 the power, and weighs 1/8 as much. The techniques developed can readily be extended to develop the synthesizer for use to at least 50 megacycles. Author

N65-35648# SFD Labs., Inc., Union, N. J.
X-BAND PHASED ARRAY TUBE DEVELOPMENT First Quarterly Progress Report, 16 Nov. 1964–16 Feb. 1965
S. Sussman Mar. 1965 34 p *Its* Rept.-1
(Contract AF 30(602)-3633; ARPA Order 136)
(SFD-53-R-1; AD-613265)

The purpose is to conduct an X-band phased array tube development program. Hot testing of tubes has been completed. These tubes employed a choke supported interdigital line designed to operate in the forward wave space harmonic. The operating voltage for these tubes was about 15 kv. The best results obtained to date are 5-6 db net gain over about 500 Mc. Peak power output and gain of these tubes was limited by a lower band edge oscillation. Cold test work on lower voltage versions of these circuits was conducted. A tube of this type is approaching hot test. Effort on bending the input and output waveguide sections, using ridged waveguide bends, was initiated. A study of an alternate slow wave circuit is continuing. A magnetic cold tester, employing cylindrical magnets in a shielded package design, was constructed and tested. The initial results indicate that the required magnetic field strengths will be readily obtainable within the dimensions specified. Author

N65-35650# Texas Instruments, Inc., Dallas.
PRODUCTION ENGINEERING MEASURES (PEM) FOR A GERMANIUM MICROWAVE TRANSISTOR Quarterly Progress Report No. 3, 31 Dec. 1964–31 Mar. 1965
C. L. White, Roger R. Webster, and R. L. Petritz [1965] 65 p refs
(Contract DA-36-039-AMC-03632(E))
(TI-03-65-38; AD-617564)

In the development of an optimized design for a germanium microwave transistor capable of operating in the 1.5 to 3.0 Gc frequency range, several modifications were made in prototype design and fabrication methods. Data on the electrical characteristics, measured noise figures, and quality assurance for the devices are tabulated. The construction of a noise figure test jig is described, and evaporation technology, transistor packaging, and operating and storage life tests are discussed. M.G.J.

N65-35654# General Electric Co., Philadelphia, Pa. Spacecraft Dept.
ACCELERATED TESTING OF HIGH RELIABILITY PARTS Second Interim Technical Report, 10 Oct. 1964–10 Feb. 1965
T. M. Walsh, H. S. Endicott, G. Best, G. Bretts, H. Mc Lean et al
Griffiss AFB, N. Y., RADC, May 1965 107 p refs
(Contract AF 30(602)-3415)
(RADC-TR-65-64; AD-617141)

As a result of reliability testing of glass dielectric capacitors, data has been accumulated which offers an indication of an upper temperature limit for thermal acceleration of failures. The data which are still being gathered show that an analytical expression for insulation resistance is extremely important in formalizing the stress response of the dielectric. Preliminary analysis of high stress data indicates that the oxide film resistor, the diode and the transistors have shown significant trends or failures; however, additional work is being performed in these areas to confirm the failure mechanisms. Author

N65-35655# General Electric Co., Schenectady, N. Y. Tube Dept.
INVESTIGATION OF VARIOUS ACTIVATOR REFRACTORY SUBSTRATE COMBINATIONS Final Report
John H. Affleck and William T. Boyd Griffiss AFB, N. Y., RADC, Jun. 1965 62 p refs
(Contract AF 30(602)-3395)
(RADC-TR-65-100; AD-617779)

An investigation was conducted to examine the properties of various materials suitable for dispenser cathode systems. Work function, evaporation rate, and poisoning effects have been measured in an effort to characterize these systems. It has been shown that various barium dispenser cathode systems may have effective work functions at 1250° K in the range of 2.40 to 1.80 ev and that excess barium oxide in the matrix gives emission characteristics similar to the oxide cathode. Low mass gases such as oxygen, carbon monoxide, and carbon dioxide have deleterious effects on the barium dispenser systems while the effects of hydrogen and methane seem to depend strongly on the nature of the emitting surfaces as well as other parameters encountered in the normal testing procedure. A diode test in a commercial type of tube demonstrated the feasibility of a simplified fabrication procedure for producing a low work function emitter, $\phi = 1.80$ ev at 1250° K.
Author

N65-35656# Bulova Watch Co., Woodside, N. Y. Electronics Div.
PRODUCTION ENGINEERING MEASURE FOR TYPE CR-(XM-60)/U CRYSTAL UNITS Quarterly Report, Jan.–Mar. 1965
R. F. Woolley [1965] 23 p
(Contract DA-36-039-AMC-03633(E))
(QR-3; AD-617912)

The report details the problems involved in obtaining satisfactory copper Kold-Weld holders of the HC-6/U configuration; attempts at obtaining satisfactory lead attachment by means of ultrasonic welding techniques; results of investigations to improve processing and fabrication techniques; and results obtained during the reliability study of CR-47A/U crystal units.
Author

N65-35657# Western Electric Co., Inc., Laureldale, Pa.
PRODUCTION ENGINEERING MEASURE: MECHANIZATION FOR 2N559 AND 2N1094 TRANSISTORS, PHASE 2 Final Engineering Report, Jan. 1, 1963–Dec. 31, 1964
M. N. Reppert [1964] 347 p refs
(Contract DA-36-039-SC-72729)
(AD-617545)

Advances in state-of-the-art have increased yield and efficiency of the mechanized transistor production line. The advances, reviewed in this report, enhance the capability to produce 2N559, 2N560, 2N1051, 2N1094 and 2N1195 transistors for the Nike anti-missile systems, and result primarily from improvements to three process operations and ten mechanized operations. Those operations that were especially mechanized for high volume production of 2N559 transistors have not been improved due to redirection of anti-missile development to Nike X' The three process operations—slice diffusion, contact evaporation and alloying—had not been included in the Phase 1 scope. Hence, improvement to these operations have produced more favorable distributions on certain Group A parameters of the 2N560, 2N1051, 2N1094 and 2N1195 transistors. In no case has a parameter distribution been shifted unfavorably by process or machine alterations.
Author

N65-35684# Westinghouse Electric Corp., Philadelphia, Pa.
PRODUCTION ENGINEERING MEASURE TYPE 2N2762 SILICON ALLOY TRANSISTOR Quarterly Progress Report, 1 Jan.–31 Mar. 1965
T. E. Ebert, R. J. Pisarcik, and J. E. Priest [1965] 17 p
(Contract DA-36-039-AMC-03617(E))
(QPR-7; AD-617736)

All process improvements are reported as completed and incorporated in the manufacture of the contract device. Data are presented to demonstrate an increase of the energy level at which secondary breakdown occurs in the contract device when compared to devices fabricated using standard product techniques. A summary of progress and yield information is presented for the production run now in progress. Data for revised reliability test program are presented.
Author

N65-35692# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
CROSSED FIELD MICROWAVE TIME DELAY TUBE FEASIBILITY STUDY Final Report
Arthur Downing and John I. Smith Griffiss AFB, N. Y., RADC, May 1965 43 p ref
(Contract AF 30(602)-3508)
(PT-900; RADC-TR-65-75; AD-617694)

A six month program of theoretical and experimental investigation to determine the feasibility of developing a crossed-field microwave tube to operate as a variable time delay device was carried out. During the program, a broadband delay coupler was constructed and tested to determine the limits on bandwidth, insertion loss and signal power level. A large bandwidth fast cyclotron wave synchronous condition was obtained, but with a pronounced reduction in coupling because of the high interception current on the delay circuit. A computer study of the beam optics in a variable drift space region determined the optimum design for the drift electrode shapes and potential profile for a delay variation of at least 150 nanoseconds.
Author

N65-35700# Braddock, Dunn and McDonald, Inc., El Paso, Tex.
INVESTIGATION OF THE STATISTICS OF BREAKDOWN USING NANOSECOND PULSE TECHNIQUES Final Report
D. F. Mc Donald, C. J. Benning, and S. J. Brient Griffiss AFB, N. Y., RADC, Mar. 1965 60 p refs
(Contract AF 30(602)-2781)
(RADC-TR-64-584; AD-614286)

The experimental equipment, experimental procedures, and test results of a laboratory study of the statistics of discharge initiation in highly over-volted planar spark gaps is presented. The theory of operation of a subnanosecond rise-time multikilovolt pulse generator is described. Test data on the electron emission of different electrode materials as a function of gap field strength and electrode conditioning are presented. In addition, a simplified model of the statistics of free-space breakdown in a transmitted microwave beam is developed.
Author

N65-35701# Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.
RELIABILITY ANALYSIS OF V-BAND TUNNEL DIODES Semiannual Status Report, 25 Jun.–25 Dec. 1964
Griffiss AFB, N. Y., RADC, Apr. 1965 49 p refs
(Contract AF 30(602)-3487)
(RADC-TR-65-31; AD-615498)

This report discusses improvements in tunnel diode fabrication techniques which are under development. The basic approaches under investigation are standard product improvement, annular tunnel diode development, and solid structure tunnel diode development. Some of the innovations are an improved package, an improved reproducible alloy process which does not use spheres as alloy material, and a solid structure device which requires no etching after assembly.

Junctions produced by these techniques have been cycled 5 times from −196° C to +100° C with no change in parameters, indicating a resistance to thermal shock damage. Author

N65-35704# Harry Diamond Labs., Washington, D. C.
ANALOG COMPUTER ANALYSIS OF NETWORKS CONTAINING DIODES
Arthur Hausner 12 Feb. 1965 19 p refs
(HDL-TM-65-10; AD-615272)

Larrowe's direct simulation method of analog computer analysis of electrical networks is extended to include diodes. The technique is somewhat artificial; each diode is replaced by a small inductance, which passes current in one direction. The limit as the inductance approaches zero is simply a high-gain limited amplifier that introduces feedback to properly preserve all current and voltage equations at all times. The stability of the method is briefly discussed, and an example is given to show its effectiveness. Author

N65-35714# Harry Diamond Labs., Washington, D. C.
TRIANGULAR-WAVEFORM GENERATOR Final Report
John A. Croarkin 30 Apr. 1965 27 p
(HDL-TM-65-16; AD-616125)

A symmetrical-triangular-waveform generator has been developed. The output frequency or PRF is voltage controlled. Five discrete PRF's spanning a ten-to-one frequency range are provided. The amplitude of the output waveform is adjustable from 20 to 60 v peak-to-peak. The circuit operates within specifications over a temperature range of −65° to +165° F. Author

N65-35736# Battelle Memorial Inst., Columbus, Ohio.
RELIABILITY OF INTEGRATED CIRCUITS USED IN MISSILE SYSTEMS
J. L. Easterday, R. G. Bowman, W. L. Gahm, and B. C. Spradlin
Huntsville, Ala., Army Missile Command, RSIC, 30 Oct. 1964
72 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-330; AD-614103)

Failure rates for off-the-shelf silicon monolithic integrated circuits have been established on the basis of some 68 million part-test hours of data. No failures were reported for operating-life tests at 25° C, so it can be determined only that the failure rate is less than an upper 60 percent confidence limit of 0.067 percent per 1000 hours. The observed failure rate from system and field operational tests was 0.012 percent per 1000 hours (0.022 percent per 1000 hours at 60% upper confidence limit). At 125° C, the observed operating-life failure rate for laboratory tests was 0.087 percent per 1000 hours. Estimated failure rates for laboratory storage tests range from 0.0055 at 25° C (extrapolated) to 0.22 at 150° C, and 2.4 at 300° C. The acceleration factors for the nonoperating life tests have been estimated on the basis of the Arrhenius equation. Analyses of the available data did not reveal significant differences among the capabilities of the manufacturers of integrated circuits of this type, among the circuit configurations, nor among the circuit functions. Author

N65-35741# Compagnie Generale de Telegraphie sans Fil, Orsay (France). Centre de Physique Electronique et Corpusculaire.
GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS Technical Report No. 4, 1 Apr.–30 Jun. 1964
[1964] 29 p
(Contract AF 61(052)-715)
(WR-1344; AD-614124)

Attempts to extend the state-of-the-art of O-type carcinotron oscillators to the generation of submillimeter waves down to 0.3 mm are discussed. Fundamental technological improvements are reported in the following areas: (1) continuation of the gun studies for operation over the 6 to 10 kV range; (2) detection equipment; (3) refinement in the 0.4 mm tube adjustments; (4) machining of the components of the 0.3 mm tubes; and (5) eventual construction of improved 0.4 mm tubes. R.R.D.

N65-35758# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
HIGH POWER VARACTOR FOR UHF TRANSMISSION Quarterly Progress Report No. 2, 1 Oct.–31 Dec. 1964
G. A. Louis [1964] 32 p
(Contract DA-28-043-AMC-00278(E))
(ECOM-00278-2; AD-615329)

Both the deep diffused structure fabrication and the epitaxial diffused planar structure are described. A high frequency die testing method is discussed which allows immediate evaluation of device performance in the die stage. Completed units with efficiencies approaching 70% with output powers to 27 watts are reported. Author

N65-35760# International Business Machines Corp., Owego, N. Y. Federal Systems Div.
STUDY OF EFFECT OF HIGH-INTENSITY PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS AND MATERIALS (SCORRE) Final Report, 1 Feb. 1963–28 Feb. 1965
Frank A. Frankovsky [1965] 56 p refs *Its* Rept.-8
(Contract DA-36-039-AMC-00161(E))
(IBM-65-521-08; AD-616077)

This report contains the results of a series of experiments conducted on capacitors of the tantalum oxide, ceramic, mica, and glass dielectric types. The experiments were conducted to provide design information that would characterize the radiation response of the capacitor in terms of the dielectric material and device construction. Included also are the results of a study conducted on the behavior of a critical timer circuit in which failure modes and thresholds were determined analytically and confirmed experimentally. The studies utilized pulse reactor radiation and a high-energy electron beam. Author

N65-35772# Compagnie Generale de Telegraphie sans Fil, Orsay (France).
GENERATION OF INFRAMILLIMETRIC WAVES BY MEANS OF ELECTRONIC BEAMS Technical Report, 1 Jul.–31 Dec. 1964
[1965] 35 p
(Contract AF 61(052)-715)
(TR-5; AD-616546)

Progress is reported in tube technology. With the first 0.4 mm tube operating in cw condition, the best of the silicon detectors gave 0.1 to 0.2 mV per mW. The same detector gave 1 to 1.5 mV per mW over the 0.5 mm band, indicating an increase in sensitivity of 5 to 10 times. Also, a few milliwatts were obtained on the band between 682 and 766 Gc/sec. The overall design of guns and of the tubes has been improved during the program. High voltage handling can now be obtained over the ten kV range. A good electrical insulation was achieved at large voltage by enlarging the gun diameter and the radial thickness of the aluminum oxide pieces. Also, the arcing phenomena coming from an outgassing process in alumina pieces was eliminated by careful baking in a high vacuum and at a temperature higher than 1200° C. E.E.B.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-34735 Joint Publications Research Service, Washington, D. C.

CRITERION FOR REALIZABILITY OF A LOGICAL FUNCTION BY A THRESHOLD ELEMENT

V. N. Borisov and V. A. Fedoseyev *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 95–102 refs (See N65-34725 23-34) CFSTI: $6.00

A criterion is proposed which permits without carrying out awkward calculations establishment of realizability using one threshold element for a logical function given in the form of a truth table of values. The criterion uses the concepts of code distance and minimum subcube and proposes carrying out of no more than m(m – 1)/2 checks with code combinations of binary variables where m is the number of unit or zero values of the logical function. Author

N65-34736 Joint Publications Research Service, Washington, D. C.

SOME PROCEDURES FOR CONSTRUCTION OF SYSTEMS OF MAJORITAL ELEMENTS

V. I. Varshavskiy and L. Ya. Rosenblum *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 103–110 refs (See N65-34725 23-34) CFSTI: $6.00

Means of synthesizing systems of three and five input majorital elements are investigated by simultaneous exclusion of several variables. R.N.A.

N65-34737 Joint Publications Research Service, Washington, D. C

MINIMIZATION OF THE STRUCTURE OF RELAY DEVICES WITH OUTPUTS

G. B. Tumanyan *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 111–122 refs (See N65-34725 23-34) CFSTI: $6.00

Some relationships of exclusive, non-exclusive and approximate functional expansions are investigated, and also specific properties of such expansions are derived. With the help of these properties and relationships in the process of minimization of the structure of electronic relays with many outputs explicit and inexplicit interdependencies among the expressions of boolean functions of individual outputs are explained and considered; simplification along the desired lines in the obtaining of more economical systems is also brought about. Author

N65-34740 Joint Publications Research Service, Washington, D. C.

A PROBLEM IN RESERVING IN SYSTEMS WITH A RAMIFIED STRUCTURE

I. A. Ushakov and Yu. K. Komenkov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 144–147 refs (See N65-34725 23-34) CFSTI: $6.00

A procedure is proposed for evaluating the probability of executing a task by the output (executive) elements of a system with a ramified structure where these elements are reserve elements for each other. Author

N65-34744 Joint Publications Research Service, Washington, D. C.

THE IMAGE POINT IN A SLIDING PLANE IN SYSTEMS WITH VARIABLE STRUCTURE

S. V. Yemel'Yanov, V. A. Taran, and V. I. Utkin *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 184–193 refs (See N65-34725 23-34) CFSTI: $6.00

An automatic control system of the third order with variable structure is investigated. It is assumed that in the phase space of the coordinates of the system there is some plane at each point of which the sliding condition exists where the motion of the system in the sliding condition has high dynamic properties. For obtaining the required quality indices for the control process it is necessary that the sliding condition always arise in the system. In the given article the conditions for the image point falling in the sliding plane under arbitrary initial conditions are formulated and proved. Author

N65-34745 Joint Publications Research Service, Washington, D. C.

ON THE PROBLEM OF INVESTIGATION OF THE DYNAMICS OF OPTIMAL REGULATORS

A. S. Anisimov and A. I. Vasil'Yev *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 194–208 refs (See N65-34725 23-34) CFSTI: $6.00

A qualitative picture of the dynamics of an optimal (with respect to rapid action) regulator with an asynchronous two-phase servomotor for step input action is investigated with piecewise-linear approximation of the switching line and replacement of the ideal relay characteristics by characteristics of another type. It is shown that depending on to which side the real switching line is shifted with respect to the ideal switching line, the transient process in the system has either oscillatory characteristics or goes into the sliding condition. For the first case analytical expressions are established which relate the parameters of the object and the regulator in general form with the quality indices of the transient process. Author

N65-34746 Joint Publications Research Service, Washington, D. C.

AUTOOSCILLATIONS AND STABILITY OF A CLASS OF SELF-ADJUSTING SYSTEMS WITH A MODEL FOR A CONSTANT CONTROL EFFECT

I. N. Krutova and V. Yu Rutkovskiy *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 209–221 refs (See N65-34725 23-34) CFSTI: $6.00

Autooscillations in self-adjusting systems with a model are investigated by the harmonic balance procedure for constant parameters of the object and a constant control effect. It is shown that the stability of the investigated class does not depend on the coefficient of self-alignment of the object and the amplification coefficient of the regulator. Expressions are derived for selection of the parameters of the self-adjustment curves. Author

N65-34747 Joint Publications Research Service, Washington, D. C.

SELECTION OF A DIAGRAM AND ANALYSIS OF A SEARCH-FREE SELF-ADJUSTING SYSTEM WITH A STANDARD MODEL

S D Zemlyakov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 222–238 refs (See N65-34725 23-34) CFSTI: $6.00

In the article problems in the construction of a self-adjusting system for a control object of the second order with an inertialess regulator are investigated. An approximate investigation is carried out of a control system with self-adjustment curves. Author

N65-34749 Joint Publications Research Service, Washington, D. C.

A PROCEDURE FOR SYNTHESIS OF RELAY AUTOMATIC CONTROL DEVICES WITH HIGH DYNAMIC PROPERTIES

O. G. Varshavskiy *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 256–263 refs (See N65-34725 23-34) CFSTI: $6.00

A procedure is investigated for the synthesis of automatic regulators with high dynamic properties based on the correction of the linear part of the system for approximation of it to a system of the second order. In the regulators a nonlinear transformation of the signal of the derivative of the control variable is used or its equivalent depending on the dynamic properties of the given part of the system. Some particular cases are investigated including the synthesis of the regulator for control of a system with delay. Author

N65-34750 Joint Publications Research Service, Washington, D. C.

SYNTHESIS OF CORRECTION DEVICES OF AUTOMATIC CONTROL SYSTEMS WITH RESPECT TO THE QUASI-INVARIANCE CONDITION

A. B. Kantorovich and A. A. Vasil'yev *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 264–274 refs (See N65-34725 23-34) CFSTI: $6.00

The problem of synthesis of correction devices, automatic control systems for which satisfactory realizability criteria exist for conditions of total invariance, is investigated. Accurate fulfillment of these conditions is not required. The limits of allowable deviation when fulfilling the conditions of total invariance are determined by the given quality indices for the automatic control system. The solution is reduced to the form which permits use of logarithmic amplitude and frequency phase characteristics. Author

N65-34753# Joint Publications Research Service, Washington, D. C.

AUTOMATION, NO. 1, 1965

2 Sep. 1965 133 p refs Transl. into ENGLISH of the periodical Avtomatyka (Kiev), 1965 p 3-93 (JPRS-31831; TT-65-32326) CFSTI: $4.00

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N65-34754 Joint Publications Research Service, Washington, D. C.

ESTIMATING THE OPTIMAL ORDER OF THE TRIGONOMETRIC POLYNOMIAL APPROXIMATING THE INPUT FUNCTION

M. A. Dukhovniy and Ye. G. Faynshteyn *In its* Automation No. 1, 1965 2 Sep. 1965 p 1–8 refs (See N65-34753 23-10) CFSTI: $4.00

Formulas are evolved to estimate the order of the trigonometric polynomial approximating the input function in a linear system. Errors due to the approximation are held to a minimum, and the case of a uniform approximation is considered. The optimal order estimates are shown to be dependent on the differential properties of the input functions. Equations are developed when the order of the approximating polynomial equals zero, when it approaches unity, and when it has other values. M.W.R.

N65-34755 Joint Publications Research Service, Washington, D. C.

CONTROLLING MODELS IN MULTIVARIABLE AUTOMATIC SYSTEMS

K. D. Zhuk *In its* Automation, No. 1, 1965 2 Sep. 1965 p 9–23 refs (See N65-34753 23-10) CFSTI: $4.00

Multivariable objects have been classified so that the P-, V-, and H-canonic structures are isolated, and it has been shown that these structures are individual cases of the complete object operator. While the elements of the complete operator H must be single-valued and continuous, they can be linear, nonlinear, algebraic, or differential relationships. An autonomous and invariant control system can be constructed by the inverse operator method for a broad class of multivariable objects which corresponds to a continuous H operator. Control parameters are selected on the basis of the power requirements of the object; and certain elements form an analog of the inverse function of the force controllers. Simulation of the inverse operators of the direct connection assures transmission of signals to the output of the object without changes or lags. Structural peculiarities of a multivariable system with a control model in the feedback path are considered, construction of an inverse analog is shown, and operator matrix is discussed. A multivariable system with a lead model is also developed. M.W.R.

N65-34756 Joint Publications Research Service, Washington, D. C.

GRAPHO-ANALYTICAL METHOD FOR CONSTRUCTING THE TRANSIENT PROCESS CURVE FOR AUTOMATIC CONTROL SYSTEMS USING A DIGITAL COMPUTER IN THE CLOSED LOOP

A. V. Novykov and V. S. Nedavniy *In its* Automation, No. 1, 1965 2 Sep. 1965 p 24–30 refs (See N65-34753 23-10) CFSTI: $4.00

A grapho-analytical method has been developed for the construction of the transient process curve for automatic control systems. This permits the investigation of transient processes in numerical servo systems by using a digital computer as a closed relay system; the continuous part of the relay system remains linear throughout. Schematics are offered for the automatic control system, with and without considering the lag of the digital computer. Steady state output device characteristics of the computer are illustrated in terms of what feeds back into the input; these take the form of an analog to digital converter. Construction of the transient process curve is shown, using a two coordinate system with two generalized abscissa axes. M.W.R.

N65-34757 Joint Publications Research Service, Washington, D. C.

THE DETERMINATION OF AN EXTREMAL CONTROL INDICATOR AND COMPUTING DEVICE ALGORITHM OF AN EXTREMAL CONTROLLER FOR INERTIAL MEMBERS

O. R. Savin and Y. Ya. Chertkov *In its* Automation, No. 1, 1965 2 Sep. 1965 p 31–42 refs (See N65-34753 23-10) CFSTI: $4.00

An indicator for extremal control is determined and an algorithm is developed for the computing device of an extremal regulator for a class of inertial objects, which includes cupola-type heating wells and steam boilers. Work effectivenes for an extremal control object is defined and diagrammed. The extremal indicator is computed from calculations of the dynamic characteristics of the inertial object, and equations are evolved for finding the value of the indicator. The equations are modified to include cases where the presence of noise or other disturbance can influence the linear link of the object under consideration. The algorithm is developed, and a numerical example is included which illustrates the integral impulse characteristics of the linear-link fuel steam from a boiler. M.W.R.

N65-34758 Joint Publications Research Service, Washington, D. C.

SYNTHESIS BY USE OF ANALOG SIMULATOR OF A HIGH-QUALITY AUTOMATIC CONTROL SYSTEM WHICH SATISFIES THE INVARIANCE PRINCIPLE

T. P. Traykov, L. A. Gunchev, and S. V. Marangosov *In its* Automation, No. 1, 1965 2 Sep. 1965 p 43–51 refs (See N65-34753 23-10) CFSTI: $4.00

The invariance principle has been applied to the synthesis of a system intended for speed control of a DC motor. Experimental investigations with an electronic simulator indicate that the proposed design for a composite system and the parameter values obtained for the compensating circuits obtain more than a hundredfold decrease in the dynamic error and completely eliminate the steady state error. Synthesis of a composite speed control and stabilization system for a DC motor is discussed, and linearized equations of the dynamics of the system elements are developed. The proposed circuit of the composite system was analyzed on an electronic analog computer to determine the optimal values of certain parameters on the simulator. Experimental investigations of the system were made on the simulator with a one-time solution regime; the basic disturbing signal appears at the system input in the form of a single-valued function, and the system is approximated by an invariant. M.W.R.

N65-34759 Joint Publications Research Service, Washington, D. C.

THE REGION OF LINEARITY FOR THE CHARACTERISTICS OF A NONLINEAR AUTOMATIC CONTROL SYSTEM

M. O. Yastrebenets'kyy *In its* Automation, No. 2, 1965 2 Sep. 1965 p 52–62 refs (See N65-34753 23-10) CFSTI: $4.00

Linear characteristics were determined for nonlinear automatic control systems for which the method of harmonic systems can be used. The automatic control system is considered not to have any resonant vibrations or free vibration, but does have vibration of a single frequency which takes place with the frequency of the disturbing input. Equations are calculated for the analysis. Examples are given for the linear characteristics region of a P-controller and an I-controller, each with a dead zone in the actuating mechanism; and the linear characteristics region of a PI-controller with amplifier saturation. A schematic diagram of the PI-controller, and graphs for the bounds of the three examples are presented. L.S.

N65-34760 Joint Publications Research Service, Washington, D. C.

SYNTHESIS OF RELIABLE SYSTEMS FROM UNRELIABLE ELEMENTS BY THE FEEDBACK METHOD, PART I

V. B. Georgiyevs'kyy *In its* Automation, No. 1, 1965 2 Sep. 1965 p 63–73 refs (See N65-34753 23-10) CFSTI: $4.00

The synthesis of reliable system from unreliable elements is investigated by using feedback methods. An information-processing servo-loop consisting of a sufficiently high number of links in which accidental malformations of information are possible when the functioning of the system becomes unreliable, is represented; and the method of increasing the reliability of the system is discussed. Schematic diagrams of links in the information processing loops are presented. Probability mathematics is used to determine the transit time of information through an automatic device link, and through a link with m parallel automatic devices. The resulting calculations indicate that increasing the reliability of system performance is connected to time excess. The general excess is determined by the necessity of finding and correcting errors. By varying the role of the duplicating elements and the processing time, reliability can be increased. L.S.

N65-34762 Joint Publications Research Service, Washington, D. C.
A CORRELATOR WITH STATISTICAL AVERAGING
G. O. Ball *In its* Automation, No. 1, 1965 2 Sep. 1965 p 92–98 refs (See N65-34753 23-10) CFSTI: $4.00

The operating principle of a correlator with statistical averaging is explained, and a block diagram of such a correlator is depicted. Calculations relating to input, cross-correlation function, dispersion, speed gain, and accuracy are worked out and the principle of constructing such a correlation analyzer is described. The analyzer still requires serious experimental verification. The absence of a varying delay block, and the advantages resulting from a correlator with statistical averaging as the speed of analysis offer interesting possibilities. L.S.

N65-34763 Joint Publications Research Service, Washington, D. C.
THE SYNTHESIS OF OPTIMAL AUTOMATIC SYSTEMS BY THE METHOD OF DYNAMIC PROGRAMMING
L. M. Boychuk *In its* Automation, No. 1, 1965 2 Sep. 1965 p 99–106 refs (See N65-34753 23-10) CFSTI: $4.00

The use of the dynamic programming method for the synthesis of optimal control of nonlinear objects is investigated. It is shown that for the optimality criterion, the solution of the problem can be simplified if instead of searching in each step for the optimal control value, the search is made for the optimal value of the n-th derivative of the controlled quantity. In the latter case the solution process does not depend on the form of the object equation. The methodology is illustrated by an example for which calculations are presented. L.S.

N65-34764 Joint Publications Research Service, Washington, D. C.
ON TWO SCHEMES OF DISCRETE REMOTE MEASUREMENT
B. S. Didyk *In its* Automation, No. 1, 1965 2 Sep. 1965 p 107–114 refs (See N65-34753 23-10) CFSTI: $4.00

Two discrete remote measurement systems, which work analagously to a frequency combined remote control–remote signaling (RC-RS) device, are described. Diagrams are presented showing a remote measurement system with a transducer in the form of a grey disk; the passage of current through a transmitter; the first matrix of a receiving device; a system for transforming energy into a frequency-time code; and operation of the transmitter. A detailed discussion of the circuits accompany the diagrams. L.S.

N65-34765 Joint Publications Research Service, Washington, D. C.
THE DETERMINATION OF AUTOMATION SYSTEM RELIABILITY
V. S. Novykov *In its* Automation, No. 1, 1965 2 Sep. 1965 p 115–120 refs (See N65-34753 23-10) CFSTI: $4.00

Reliability paramaters for automation systems serving a flow of demands is determined. A mass service automation system is discussed, and the input information is considered to be a stream of demands. The demand stream has the properties of being stationary and ordinary, with residual effects being absent. Graphs are presented showing the probability density for the distribution of the required time for failure-free operation (r.t.); and the dependence of the mathematical expectation on the demand stream parameter. The mathematical model establishes quantitative relationships between the intensity of the input demand stream and the reliability parameters. LS

N65-34988# California Univ., Berkeley. Operations Research Center.
MULTI-TERMINAL SHORTEST PATHS
T. C. Hu Apr. 1965 18 p ref
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-65-11; AD-618757)

The present paper gives an algorithm that finds simultaneously the shortest paths between many pairs of nodes in a given network. In the book by Berge, the values of shortest paths between many pairs of nodes are found. Here, we use a special matrix multiplication technique to find the actual arcs that are used to form the shortest paths. In a network with n nodes, $\log_2 [n-1]$ special matrix multiplications are needed to find all the shortest paths. The present paper also gives an algorithm for constructing a network with prescribed shortest distances and with the total distances associated with arcs a minimum. Author

N65-35463# College of Aeronautics, Cranfield (England).
GRAPHS IN ELECTRICAL NETWORK THEORY
S. R. Deards Apr. 1965 28 p refs Presented at the Course on Graph Theory and Its Uses, London School of Econ. and Political Sci., 13–17 Jul. 1964
(CoA-E&C-6) CFSTI: HC $2.00/MF $0.50

Presented is an analysis of fundamental theory applicable to the study of electrical networks and linear graphs. Included are data on: the graph of an electrical network, planar and nonplanar graphs, cutsets and loopsets, trees and cotrees, branch separation, cutset and loopset indexes, polarized basic cutsets, branch-cutset incidence matrices, directed basic loopsets, branch-loopset incidence matrices, the relationship between the cutset and loopset incidence matrices, basic cutset (loop-set) transformations, duality, Kirchoff's laws, electrical network analysis on a loopset- and cutset-basis, dual networks, and direct network analysis. S.C.W.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-34781 Joint Publications Research Service, Washington, D. C.
THE PURPLE MOUNTAIN OBSERVATORY TODAY
In its Transl. on Communist China's Sci. and Tech. 13 Sep. 1965 p 46–47 Transl. into ENGLISH from Hsin-Min Wan-Pao (Shanghai), 30 Jul. 1965 p 3 (See N65-34778 22-34) CFSTI: $2.00

A brief review of activities at the Purple Mountain Observatory, situated close to Nanking, is given. Studies of the planets, the solar system, satellites, astronomical instrumentation, radiation of celestial bodies, chronometry, applied astronomy, etc., are performed at this observatory. G.G.

N65-34810 Air Force Cambridge Research Labs., Bedford, Mass.
A NEW HIGH-ALTITUDE PLASTIC BALLOON LAUNCH METHOD

Francis X. Doherty *In its* Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 73–80 (See N65-34804 23-20)

A shipboard method for launching large high altitude balloons was designed for operational use aboard small, fast, maneuverable vessels. The need for expansive deck space to lay out the balloon full length for the conventional inflation and release procedure is eliminated by inflating and deploying the balloon directly from its shipping crate. A tethering technique is used to position the balloon directly over the payload, at which time the launch is made. An electro-hydraulic launching device was developed and consists of a system of rollers through which the balloon is deployed and controlled. It also has a balloon bottom end fitting tie down and release device which incorporates a free lift sensor and indicator, and a balloon transfer-deployment winch. R.N.A.

N65-34865# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.

THE DESIGN OF MAGNETIC MODELS FOR USE IN A MAGNETIC SUSPENSION AND BALANCE SYSTEM FOR WIND TUNNELS

Alan B. Copeland and Edward Lee Tilton, III Wright-Patterson AFB, Ohio, ARL, Jun. 1965 33 p refs
(Contract AF 33(615)-1470)
(ARL-65-113; AD-619271)

This report discusses the design of the magnetic portion or core of a model for use in a magnetic suspension system for wind tunnels. The calculation of the forces obtainable with a given suspension system and model, and the optimization of model core geometry and material are discussed. An example of the design of a model core is presented. Author

N65-35234*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RELIABILITY PROGRAM ELEMENTS FOR SATELLITE SYSTEMS

William Wolman [1964] 11 p Presented at the Midwest Conf. of the 1964 Quality Fair, Dallas, 15–17 Oct. 1964 Submitted for Publication
(NASA-TM-X-51608) CFSTI: HC $1.00/MF $0.50 CSCL 05A

Considered is reliability involving management, development, production and testing, at Goddard Space Flight Center, of unmanned satellites to be launched into the cislunar space. Also briefly discussed are the program elements for satellite systems. R.W.H.

N65-35268*# Bechtel Corp., San Francisco, Calif.

[DESIGN STUDIES OF SPACE ENVIRONMENT SIMULATION CHAMBERS, VOLUME I, II, III] Final Report

7 Jun. 1962 553 p refs
(Contract NAS9-419)
(NASA-CR-65158) CFSTI: HC $8.53/MF $2.75 CSCL 14B

Continued research conducted under a program focusing on the development of design criteria for a complex of space environment chambers for use in environmental testing studies, is reported. Presented is a summary description of the chambers facility selected for construction, the cost estimates, a project construction schedule, and recommended research and development. Also discussed are back-up studies conducted in support of the selection of facility characteristics for the conceptual design. Included are data on design criteria and conceptual designs of: (1) the space environment simulation chambers facility selected for construction (chamber A and B), and (2) a space chamber for systems tests under extreme vacuum (chamber D). S.C.W.

N65-35301*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EVALUATION OF THE SIMULATED SOLAR SPECTRUM IN THE JPL 25-FT SPACE SIMULATOR

A. J. Drummond, J. R. Hickey, and W. E. Schaefle 31 Aug. 1965 71 p refs
(Contract NAS7-100)
(NASA-CR-67365; JPL-TR-32-749) CFSTI: HC $3.00/MF $0.75 CSCL 14B

Detailed results of the spectral investigation of the solar simulation in the JPL 25-ft space simulator are presented. The light source consisted of 133 2.5-kw mercury-xenon compact arc lamps. Two filter radiometers, a prism monochromator, and a grating monochromator were employed. Detailed results from both techniques are presented together with the correlation philosophy and results thereof. Agreement between the two methods is within ±4%. A comparison is made with the sunlight spectrum in space, and absorptances of some surface coatings under the two light sources are tabulated. Author

N65-35324# Centre de Physique Electronique et Corpusculaire, Orsay (France).

HALF MILLIMETER "BACKWARD WAVE OSCILLATOR" Technical Progress Report No. 1, Jan. 1–Mar. 31, 1965

Apr. 1965 23 p refs
(Contract AF 61(052)-814)
(WR-1362; AD-464316)

Continued research conducted under a program designed to investigate and construct an O-type carcinotron with a center frequency of 600 KMc/s, is reported. Presented are data on tube and gun design considerations, gun sizes, magnetic focusing, magnetic field determinations, and gun construction. A first test was made with a cathode of 0.5-mm in diameter. Results of beam transmission in a channel of 0.08 to 0.09-mm in diameter are presented. Transmission was found to be poor and the operating voltage range too low. S.C.W.

N65-35334# Atomic Energy Commission, Washington, D. C.

X-RAY CHAMBER FOR USE TO 2500°C WITH A DIFFRACTOMETER

A. G. Boganov, L. P. Makarov, and V. S. Rudenko 1965 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (USSR), v. 161, no. 2, 1965 p 332–335
(AEC-TR-6559)

A high temperature vacuum X-ray chamber for studying crystal structures at temperatures above 1600°C is described. The sample is placed in a molybdenum cell and can be heated to 2000°C with the use of a tungsten radiation heater; sample temperatures above 2000°C are achieved by bombarding the sample with a focused beam of electrons from an electron gun. Temperatures as high as 3000°C can be reached by changing the sample support material from molybdenum to tungsten. The chamber was used in investigating refractory oxides, and X-ray analysis data are presented for ZrO_2 and HfO_2. J.M.D.

N65-35393*# National Aeronautics and Space Administration, Washington, D. C.

GROUND STATION COMMITTEE, CAPE KENNEDY, 1–2 DECEMBER 1964

Jan. 1965 4 p Transl. into ENGLISH from Compte Rendu de France Concernant la Station Terrienne de Pleumeur-Bodou, Centre Natl. d'Etudes des Telecommun. (France), p 1–3
(NASA-TT-F-9241) CFSTI: HC $1.00/MF $0.50 CSCL 22D

The article examines present operation and accomplishments by the Pleumeur-Bodou tracking station with the Relay and Telstar series of satellites. Technical changes now being undertaken, and projects for expanded future operation are outlined. Author

N65-35427*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GODDARD SUMMER WORKSHOP PROGRAM IN SIMULATION OF SPACE ENVIRONMENT Final Report, Jun. 15–Sep. 15, 1962
Elias Klein comp. [1962] 181 p refs
(NASA-TM-X-55292; X-320-62-193) CFSTI: HC $5.00/MF $1.25 CSCL 14B

Presented are results of an experimental summer workshop which was designed to evaluate problems relating to simulation of space environments in the laboratory. Reported are data on: solar simulation, heat transfer and cryogenic pumping in space simulation, corona and discharge effects inside spacecraft at low external pressure, magnetic field simulation, response of vehicle structure to acoustic fields, and techniques used in relating damage and reliability to environmental data. S.C.W.

N65-35503* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROLE OF APOLLO SHIPS
M. D. Greene *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 275–281 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

This presentation describes the Apollo ships program planned to provide support for the insertion/injection and reentry phases of the Apollo space flights to the moon. Discussion covers characteristics of the ships and an outline of their instrumentation systems, their coverage areas, and time schedules for completion, operational readiness, and integration into the Manned Space Flight Network (MSFN). Organizational responsibility for the Apollo ships program is also treated. Author

N65-35518*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DATA REDUCTION FOR FILTER SPECTRORADIOMETRY
Ralph E. Wagoner and John L. Pollack Washington, NASA, Oct. 1965 17 p refs
(NASA-TN-D-3037) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Two methods are presented for determining spectra from filter spectroradiometer data. The first method uses only data from the filter spectroradiometer, while the second combines these data with monochromator radiometer data. The result, in either case, is a computed spectral curve that is consistent with the experimental data. To illustrate the data reduction techniques, sample spectra from a carbon arc solar simulator are given. The experiment is performed to determine the degree of agreement of measurements on the same source by the monochromator and filter instruments. Author

N65-35561# Advisory Group for Aeronautical Research and Development, Paris (France).
AGARD INFORMATION BULLETIN
Jun. 1965 23 p
(Rept.-65-2)

The AGARD technical program for 1966 is mentioned by subject for the various panels, and changes in membership and publications are listed for each of the panels. Technical panels include Aerospace Medical, Avionics, Combustion and Propulsion, Flight Mechanics, Fluid Dynamics, Structures and Materials, and Technical Information. Titles of lectures are given for three AGARD lecture series: (1) Space Navigation, Guidance, and Control; (2) Engineering Applications of Advanced Techniques of Random Process Analysis; and (3) Guided Missile Engineering. New AGARD publications are given in an annotated bibliography and a calendar of AGARD meetings is included. M.W.R.

N65-35649# Ling-Temco-Vought, Inc., Dallas, Tex. Aeronautics Div.
RAPID SITE PREPARATION FOR TURBOJET VTOL AIRCRAFT Technical Documentary Report, 1 Oct. 1963–31 Aug. 1964
J. E. Butler and G. F. Thomas Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Oct. 1964 109 p refs
(Contract AF 33(651)-1092)
(APL-TDR-64-125; AD-613342)

A sprayable, rapid-curing, light-weight, low-cost material system for use as a remote landing and take-off site for turbojet VTOL aircraft was developed. The material system was composed of a chlorinated polyester resin system modified with temperature resistant additives and fiber glass reinforcement. The capabilities of the material system were demonstrated by testing in the direct exhaust of an afterburning J85-GE-5 turbojet engine in the jet test facility, and by an operational field site used for repeated take-off and landings of an X-14A jet VTOL aircraft. The material system withstood temperatures up to 3000° F for short time periods. It is believed that the basic VTOL landing site area exposed to the severe temperatures and velocities of a jet engine exhaust can be fabricated using a maximum of 2.5 lbs/ft^2. Author

N65-35697# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WIND-TUNNEL BALANCE
V. N. Ovchinnikov 2 Jul. 1965 8 p Transl. into ENGLISH from Soviet Patent No. 148261 (Appl. No. 740917/26, 5 Aug. 1961) 4 p
(FTD-TT-65-236/1+2+4; AD-617680)

A wind tunnel balance which contains a sensor, string frequency pickup, and electronic circuit is described. The device was designed for investigation of the aerodynamic characteristics of models in wind tunnels and gas-dynamics measurements. The balance is characterized by high precision. E.E.B.

N65-35761# Army Electronics Labs., Fort Monmouth, N. J.
TECHNIQUE FOR PULSING THE ELECTRON BEAM OF A VAN DE GRAAFF PARTICLE ACCELERATOR
Gerald Healey Mar. 1965 14 p ref
(ECOM-2564; AD-616923)

The need for a pulsed high energy gamma source as a research tool, with the capability of changing the pulse profile, is filled by slightly modifying a Van de Graaff accelerator set up to run in a negative mode. The modification consists of triggering by means of an external pulsed light source. The light pulse is sensed and followed by a photo cell located in the control pentode on the high voltage terminal. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-34856# Purdue Univ., Lafayette, Ind. School of Aeronautics, Astronautics and Engineering Sciences.
THEORY OF MICROPOLAR FLUIDS
A. Cemal Eringen Jul. 1965 37 p refs
(Contract Nonr-1100(23))
(TR-27; AD-469176)

Equations of motion, constitutive equations and boundary conditions are derived for a class of fluids named micropolar fluids. These fluids respond to micro-rotational motions and spin inertia and therefore, can support couple stress and distributed body couples. Thermodynamical restrictions are studied in detail and field equations are obtained for the density, velocity vector and micro-rotation vector. The system is solved for a channel flow exhibiting certain interesting phenomena. Author

N65-34917# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut für Luftstrahlantriebe.
TESTS ON THE TRANSONIC CASCADE TUNNEL. PART 1: INSTALLATION OF THE NACA/7-INCH TRANSONIC CASCADE TUNNEL AT THE DVL, DEVELOPMENT OF INSTRUMENTATION, AND PRELIMINARY TESTS [UNTERSUCHUNGEN AM TRANSONIC-GITTERWINDKANAL. TEIL 1: AUFBAU DER NACA-7-INCH-MESSTRECKE IN DER DVL ENTWICKLUNG DER MESSANLAGE UND VORVERSUCHE]
W. Heilmann Jul. 1965 48 p refs In GERMAN; ENGLISH summary
(DVL-415; DLR-FB-65-31) CFSTI: HC $2.00/MF $0.50

So far, predetermination of the flow in compressors and turbines operating with transonic velocities in the blade rows has not been possible, and one has to depend on a limited scope of available measurements. Therefore, the test-section of the NACA 7-inch transonic cascade tunnel, which was made available to the DVL on a loan basis, has been installed at the DVL, equipped with new instrumentation, and put into operation. Author

N65-34949*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
INVESTIGATION TO DEFINE THE PROPAGATION CHARACTERISTICS OF A FINITE AMPLITUDE ACOUSTIC PRESSURE WAVE, PHASE 1 Final Report, 29 Jun. 1964–29 Jul. 1965
A. C. Peter and T. C. Li [1965] 84 p refs
(Contract NAS8-11441)
(NASA-CR-67200; SID-65-933) CFSTI: HC $3.00/MF $0.75 CSCL 01A

The contribution of high entropy production regions to the generation and propagation characteristics of a finite amplitude pressure wave is considered. Preliminary analysis indicates that, for nozzles where pressure ratios are above critical, the predominant contribution may come from the shock layer formation in the exhaust region. Temperature effects indicate high dependence of the forcing function upon the initial temperature of the media. Author

N65-34972*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SIMILARITY IN CONFINED VORTEX FLOWS
E. J. Roschke and T. J. Pivirotto 15 Aug. 1965 22 p refs
(Contract NAS7-100)
(NASA-CR-67210; JPL-TR-32-789) CFSTI: HC $1.00/MF $0.50 CSCL 20D

Results of an experimental investigation designed to test a simplified theory for obtaining dynamic similarity in confined vortex flows are presented. The simplified model from which similarity is obtained consists of the vortex flow of dissimilar fluids under conditions of exact geometric similarity. Steady, laminar, viscous, compressible flow in a two-dimensional, axisymmetric vortex is considered. The experiment consists of end-wall pressure measurements using the two diatomic gases, nitrogen and hydrogen, in identically the same vortex apparatus. The results of this investigation tend to show that simplified theories of vortex flow are insufficient, but the degree or precise manner of their defect cannot be delineated. Examination of another set of data using the identical vortex apparatus disclosed that dynamic similarity in static-pressure distributions (measured at the closed end-wall) between tests using nitrogen and hydrogen could be closely approached by conducting the tests at equal values of static pressure at the cylindrical wall. Some of the latter results are presented and discussed. Author

N65-34980# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
CONTRIBUTION TO THE STUDY OF THE TURBULENT BOUNDARY LAYER ALONG CORRUGATED PLATES [CONTRIBUTION A L'ETUDE DE LA COUCHE LIMITE TURBULENTE LE LONG DE PLAQUES RUGUEUSES]
Dieter Bettermann Jun. 1965 80 p refs In FRENCH
(Rept.-65-6) CFSTI: HC $3.00/MF $0.75

Investigations were made into the relationship between the turbulent boundary layer flow along a corrugated plate as compared with the flow along a smooth plate. The corrugation consisted of a series of crosswise ridges situated perpendicularly to the flow. An analysis of measurements taken in a wind tunnel and heating system is provided. Transl. by G.A.L.

N65-34995# California Univ., Berkeley. Inst. of Engineering Research.
THE LAMINAR COMPRESSIBLE WAKE BEHIND VERY SLENDER BODIES
R. H. C. Au and S. A. Berger Jul. 1965 25 p refs
(Contract Nonr-222(45))
(AS-65-8; AD-469633)

Approximate solutions for the compressible laminar wake which are valid within the entire wake region extending from the rear stagnation point of a slender body are presented for two-dimensional and axially symmetric flows. The solutions are obtained from the linearized momentum and energy equations, neglecting streamwise pressure gradient. These equations are reduced to the form of the diffusion equations. The results are applicable to wakes from slender bodies which are very thick when compared to the transverse dimension of the body. In particular, the result for the axially symmetric case is directly applicable to the wake from a long slender circular rod immersed in a low Reynolds number, supersonic stream. The solution is applied to the simplified case of an axially symmetric flow with the Prandtl number equal to one and centerline velocity small compared to free stream velocity. Author

N65-35007# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
PROPAGATION OF SMALL DISTURBANCES IN TWO PHASES, ONE COMPONENT FLOW [PROPAGATION DE PETITES PERTURBATIONS DANS UN ECOULEMENT DOUBLE PHASE A UN SEUL CONSTITUANT]
J. Boure 1963 76 p refs In FRENCH; ENGLISH summary
(CEA-2316) CFSTI: HC $3.00/MF $0.75

A small disturbance is shown to give rise to two waves: a pressure (sonic) wave and a continuity wave. Their propagation velocities are calculated. These velocities are independent of the disturbance amplitude. The sonic velocity is primarily a function of that one corresponding to the same medium with no flow and of the liquid phase velocity. It is also a function of the physical properties of the phases on the saturation line, of the slip laws and of the void fraction. The continuity wave velocity is only a function of the slip laws, of the void fraction and of the velocity of either phase. The void fraction and the liquid and the gas velocities are calculated. These results are extended to the case of a real loop and an approximative method is given for the treatment of this case. .. Author

N65-35044# RAND Corp., Santa Monica, Calif.
A REVIEW OF HYPERSONIC WAKE STUDIES
P. S. Lykoudis May 1966 91 p refs
(Contract ARPA-SD-79; ARPA Order 189-61)
(RM-4493-ARPA; AD-617107)

A critical summary of studies in the fluid mechanics of hypersonic wakes formed behind vehicles of different geometries. The memorandum reviews both the history and the special problems of the field, and gives special attention to such issues as the laminar regime, transition to turbulence, and turbulence. The author concludes that, while progress has undoubtedly been made in the last five years when hypersonic wakes have been investigated in a systematic way, much work remains to be done. Author

N65-35069*# Cornell Univ., Ithaca, N. Y.
THE DYNAMICS OF CRYOSORPTION PUMPING
S. H. Bauer and Peter Jeffers Washington, NASA, Oct. 1965 12 p refs
(Grant NsG-116)
(NASA-CR-314) CFSTI: HC $1.00/MF $0.50 CSCL 20D

A technique has been developed for the rapid injection of gas samples into a low pressure system (Knudsen regime), and for faithfully recording the consequent changes in pressure. The experimental procedure may be used for measurement of initial rates of adsorption on a millisecond time scale, and in this investigation was used for dynamically testing the speed of cryosorption pumping of air, argon and hydrogen by activated charcoal (temperature: liquid nitrogen). The utility of cryosorption pumping has been demonstrated for the rapid removal of bursts of gas as well as for obtaining and holding pressures down to 10^{-8}–10^{-7} mm Hg. The initial pumping rate is limited by a "geometric" sticking coefficient, which depends on the gas. After about 10 milliseconds the pumping rate declines and appears to be limited by the rate of diffusion of molecules into the cracks and pores of the large area adsorbent. Author

N65-35085# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
[RESEARCH ON PROBLEMS OF VISCOUS FLOW] Final Summary Report, Aug. 1958–Aug. 1965
John D. Buckmaster Aug. 1965 46 p
(Contract Nonr-2653(00))
(CAL-AF-1285-A-16; AD-619371)

A summary is presented of the work done in the areas of hypersonic viscous flows, boundary layer stability, dispersion effects of chemical relaxation, separated flows with radiation, and the assumption of a specific heat ratio near unity. TAB

N65-35156# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
AN EXTENDED TWO-FLUID MODEL FOR THE NORMAL SHOCK STRUCTURE PROBLEM
K. Toba and J. D. Melnick 5 Aug. 1964 59 p refs
(SM-47684)

The problem of normal shock structure is reviewed and presented from the standpoint of solving the Boltzmann equation. A bimodal distribution method used by Mott-Smith, and a two-fluid model advanced by Glansdorff and by Ziering and co-workers is discussed, and tentative calculations are made concerning some details of the inelastic collision mechanism in the two-fluid theory. A cut-off relative velocity leads to several parameters in the transfer equations, which are equivalent to the collision frequencies used by Glansdorff and by Ziering, et al. Numerical results were carried out for several molecular models, and generally agree with those obtained by Mott-Smitt and by Ziering. The results appear to bridge the results obtained by the Navier-Stokes analysis for weak shocks with those obtained by the Mott-Smith analysis for strong shocks, but need further work to obtain a rigorous justification. L.S.

N65-35159# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).
TWO-PHASE FLOW MEASUREMENT WITH SHARP- EDGED ORIFICES AND VENTURIS
E. Bizon Jun. 1965 56 p refs
(AECL-2273) CFSTI: HC $3.00/MF $0.50

This report contains the results of a series of two-phase flow measurements performed at 1200 psig with orifices of diameter ratio 0.45 and 0.70 and a venturi of diameter ratio 0.58 on steam-water mixtures at 1200 psig. Steam weight fractions were between 5 and 50% while mass flow was between 150 000 and 400 000 lb/hr ft^2. Dimensionless correlations for each device were obtained and a confidence interval for the correlation coefficients was computed. Author

N65-35167# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
NUMERICAL SOLUTIONS FOR MERGING SHEAR FLOWS
N. Rott and R. J. Hakkinen Feb. 1965 36 p refs
(SM-47809)

The representative cases chosen range from the merging of two identical flows above and below the plate, i.e., shear ratio of unity, to "base flow," i.e., the lower flow initially at rest and the shear ratio equal to zero. The similarity analysis based on the boundary layer assumptions yields for each shear ratio a doubly infinite family of solutions, the free parameters being the magnitude of the induced pressure field and an arbitrary shift of the entire merging flow field in terms of the lateral similarity variable. In regard to the first degree of freedom, two representative cases are chosen: no induced pressure field, and an induced pressure field corresponding to intersection of asymptotic velocity profiles at zero velocity. The latter choice, combined with the freedom to choose the origin of the normal coordinate, permits the asymptotic velocity profiles to remain unshifted with respect to the free stream, corresponding to a condition first introduced by Li and Murray. Author

N65-35190# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOLVING A LINEARIZED AXIALLY-SYMMETRICAL PROBLEM OF POINT EXPLOSION IN A MEDIUM WITH VARIABLE DENSITY

V. P. Karlikov 29 Jul. 1965 88 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 101, no. 6, 1955 p 1009–1012

(FTD-TT-65-557/1+4; AD-619325)

For description of a sharp point explosion in gas with variable density, a system of gas dynamics equations for axially-symmetric adiabatically unstable movement is formulated and solved. J.M.D.

N65-35270*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

STATIC AND DYNAMIC BEHAVIOR OF THE LIQUID-VAPOR INTERFACE DURING WEIGHTLESSNESS

E. W. Otto [1964] 65 p refs Presented at the AGARD Fluid Dyn. Panel Specialists' Meeting, Marseille, 20–24 Apr. 1964

(NASA-TM-X-52016) CFSTI: HC $3.00/MF $0.75 CSCL 20D

The problems encountered in attempting to operate systems containing a free liquid-vapor interface in a weightless environment are summarized. The literature reporting the research applicable to or directed toward solutions for these problems is reviewed. Results of the research defining the configuration of the interface as a function of liquid properties and system geometry are discussed. The results of experimental studies of the dynamic behavior of the interface in response to changes in gravity level, to outflow disturbances, and to acceleration disturbances are presented. This study places particular emphasis on determination of the scaling laws that permit prediction of the interface behavior as a function of model size. Author

N65-35323# General Applied Science Labs., Inc., Westbury, N. Y.

A NEW TECHNIQUE FOR THE NUMERICAL ANALYSIS OF NON-EQUILIBRIUM FLOWS

Luigi Moretti 4 Mar. 1964 46 p

(Contract AF 33(657)-10463)

(TR-412; AD-466922)

A new technique for the computation of inviscid flows with finite rate chemistry is presented. The case of hydrogen–air combustion is studied in full detail, but this technique can be applied to other mixtures. Difficulties due to instability in existing techniques are eliminated. Consequently, the stepsize in the numerical finite difference procedure can be increased by 2 to 4 orders of magnitude. Lengthy calculations which make the programming of two-dimensional flows with finite rate chemistry uneconomical are reduced to a few seconds on a high-speed computer. A comparison of results of this technique with that of other techniques is presented. Author

N65-35379# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany).

CONTRIBUTION TO THE IMPLOSION OF A HOLLOW SPHERE CONSIDERING THE COMPRESSION WORK IN THE FLUID [BEITRAG ZUR IMPLOSION EINER FLUSSIGKEITSHOHLKUGEL UNTER BERUCKSICHTIGUNG DER KOMPRESSIONARBEIT IN DER FLUSSIGKEIT]

K. Grümmer Aug. 1965 29 p refs In GERMAN; ENGLISH summary

(DLR-FB-65-36) CFSTI: HC $2.00/MF $0.50

It is computed, using simplifying assumptions, how in the course of the implosion the kinetic energy is consumed by the compression work, which is performed due to the increase of pressure in the fluid. The diminution of volume is not determined. In the present report a p–v isentrope of water is constructed up to a pressure of 10^{10} at. By means of this isentrope the isentropic compression energy for water is set up within the same range as a function of density and pressure respectively. The values for the mass of the hollow sphere and its kinetic energy are chosen with respect to the tests performed. Author

N65-35381# Aircraft Research Association, Ltd., Bedford (England).

THE MEASUREMENT OF TURBULENT WALL SHEAR STRESS

Ingo Rechenberg Aug. 1965 18 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), v. 11, no. 11, Nov. 1963 Presented at the 1st Session of the WGL Sub-Committee for Aerodyn. Testing Tech., Aachen, 26 Apr. 1962

(ARA-LIB-TRANS-11) CFSTI: HC $1.00/MF $0.50

The experimental determination of the local shear stress of a boundary layer close to the wall is known to be a difficult task, as is shown by a brief description of the methods used in the past. In 1954, a strikingly simple method became known with the Preston tube, a method based on the condition of general validity of the universal law of turbulent boundary layers over walls. Experimental results so far available regarding this law, as well as immediate examinations of Preston tubes, appeared rather more against this new method than in its favour. In the present paper a new experimental method is developed eliminating numerous sources of error which would have occurred in previous experiments. The latest experiments present an excellent confirmation of the Preston tube as an extremely accurate instrument for measuring wall friction of various turbulent boundary layers. One first success with this new method is the discovery of an unexpected regular variation of wall friction normal to the direction of flow in some of the investigated turbulent boundary layers. Author

N65-35401*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CONTACT-SURFACE TAILORING IN REAL SHOCK TUBES

Theodore A. Brabbs and Frank E. Belles Washington, NASA, Oct. 1965 14 p refs

(NASA-TN-D-3043) CFSTI: HC $1.00/MF $0.50 CSCL 20D

To obtain steady and well-defined conditions behind reflected shocks, the contact surface is often tailored by calculating the operating conditions that should produce tailoring, and by recording a pressure history to confirm the absence of pressure excursions due to interaction of the reflected wave with the contact surface. Pressure records are presented to show that the equilibrium pressure (p_e) after interaction can be confused with the tailored reflected pressure (p_5), if the records are only considered qualitatively. Quantitative measurements of p_5 and p_e/p_5 were made for $CO_2 + Ar$ and $CO_2 + Ar + He$ mixtures, and for N_2 driven by He. Plots of p_e/p_5 against incident Mach number (M_s) show that tailoring occurs at an M_s quite different from the calculated value. Consideration of real gas effects in the tailoring calculation does not eliminate the discrepancy. However, if the actual relation between diaphragm pressure ratio and M_s is substituted for the ideal relation assumed in tailoring calculations, accurate predictions of the tailored M_s result. This suggests a simple and rapid way to find the conditions for producing tailored operation in a given driver-driven gas combination. R.N.A.

N65-35420# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRODUCING HIGH-VELOCITY GAS JETS
A. Ye. Voytenko 4 Aug. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 6, 1964 p 1278–1280
(FTD-TT-65-542/1+2+4; AD-619323)

Described is a device that produces gas jets of great velocity through acceleration of gas in a narrow clearance formed between the forward wall of a compression chamber and the compressing plate in the top of the chamber. The compression is produced by several powerful shock waves which increase the temperature and pressure of the gas and convert it into a plasma of great density. The plasma passes through an opening into a glass exhaust tube where it can be measured by photochronograph. The use of compressing plates with a thickness of less than 1 mm decreased the jet velocity by a factor of several times. Pressures of 10^{-1} to 10^{-2} produced a jet of ~60 km/sec for an output tube of 8 mm diameter.
G.G.

N65-35423# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
[EXCITED STATE SPECTROSCOPY USING A Q-SWITCHED RUBY LASER. LOCALIZED EXCITONS IN MIXED ALKALI HALIDES] Progress Report, Oct. 1, 1964–Sep. 30, 1965
Paul L. Hartman and Herbert Mahr Jun. 1965 7 p refs
(Contract Nonr-401(47))
(AD-619198)

Studies in the following areas are summarized: light absorption in the presence of excited states (strongly populated using a Q-switched laser) in KI, CsI, and RbBr; lifetimes of the relaxed excited state of F-centers in KI, CsI, RbBr and CsF; absorption edge of I^- in KBr single crystals; process of F-center formation with ultraviolet light of mixed and pure alkali halides.
Author

N65-35513# Royal Aircraft Establishment, Farnborough (England).
CYBERNETIC SOLUTION PATH OF AN EXPERIMENTAL PROBLEM [KYBERNETISCHE LOSUNGSANSTEUERUNG EINER EXPERIMENTELLEN FORSCHUNGSAUFGABE]
Ingo Rechenberg Aug. 1965 22 p Transl. into ENGLISH from German Presented at WGLR Ann. Conf., Berlin, Sep. 1964
(RAE-LIB-TRANS-1122) CFSTI: HC $1.00/MF $0.50

An evolution strategy according to Darwin is applied to the problem of finding the body shape which gives the smallest drag within a certain class of bodies. It is shown that there are cases where the evolution strategy is superior to the method of steepest descent and to the Gauss–Seidel strategy. The method is applied to the simple case of a kinked plate.
Author

N65-35522*# McDonnell Aircraft Corp., St. Louis, Mo.
A WAVE-GUIDE MODEL FOR TURBULENT SHEAR FLOW
Marten T. Landahl Washington, NASA, Oct. 1965 21 p refs (Contract NAS1-3179)
(NASA-CR-317) CFSTI: HC $1.00/MF $0.50 CSCL 20D

A theory is presented in which the pressure fluctuations in a turbulent boundary layer, or other almost parallel shear flow, are expressed in terms of integrals involving squares of the fluctuating velocity components. The analysis indicates that the resulting disturbance will be dominated by shear waves, i.e., the mean shear flow acts as a wave guide for the disturbances created by the turbulent breakdown. The wave propagation constants can be obtained by solving a modified Orr–Sommerfeld stability problem for the turbulent mean velocity profile. From these propagation constants one can then determine statistical properties of interest, e.g., how the cross-power spectral density varies with distance.
Author

N65-35543# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ENGINEERING ANALYSIS OF BOUNDARY LAYERS AND SKIN FRICTION ON BODIES OF REVOLUTION AT ZERO ANGLE OF ATTACK
D. J. Eckstrom May 1965 56 p refs
(TM-55-21-21; LMSC-805162)

The reference temperature method of predicting skin friction coefficients for supersonic flow with heat transfer is described in detail. Techniques which are simple enough for practical engineering application are presented for applying the methods to bodies of revolution consisting of a cone, cylinders, and conical frusta. A sample calculation is carried out, and a significant improvement over the traditional insulated flat plate method is found. The influences of compressibility and heat transfer on the growth of boundary-layer thickness, momentum thickness, and displacement thickness on a flat plate with zero pressure gradient are presented. The literature concerning boundary-layer transition is reviewed, and the influence of several of the more important parameters evaluated. Throughout the report, only the zero angle of attack case is considered.
Author

N65-35567# Illinois Univ., Urbana. Dept. of Chemistry and Chemical Engineering.
INVESTIGATION OF WALL TURBULENCE USING A DIFFUSION-CONTROLLED ELECTRODE Report No. 1
James E. Mitchell, (Ph.D. Thesis) Jul. 1965 151 p refs
(Grant AF-AFOSR-547-65)
(AFOSR-65-1199; AD-619304)

This study was performed to demonstrate that a diffusion-controlled electrode technique can be used to measure the average and fluctuating shear stresses at a pipe wall and to obtain a better understanding of the structure of turbulence near the wall. The technique was established after compensations for two effects, also common to the hot wire anemometer, were determined. The problem of non-uniform flow across the electrode was solved by determining experimentally a correction factor, whereas the problem of the time response of the electrode to fluctuations in the shear stress was handled by numerically solving the governing equations. The data for fully developed turbulence showed that the limiting velocity intensity at the wall was 0.32, based on the local average velocity, and that it was independent of Reynolds number. The circumferential scale was found to be very small near the wall but the longitudinal scale did not decrease from the values reported for the center of a pipe. Some velocity disturbances near the wall appeared to be as large as the local average velocity. A simplified model for a low frequency disturbance near the wall was investigated and found to be promising although several of the assumptions were not well substantiated.
Author

N65-35614# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SPECTROSCOPIC STUDIES OF VIBRATIONAL NONEQUILIBRIUM IN SUPERSONIC NOZZLE FLOWS
I. R. Hurle, A. L. Russo, and J. Gordon Hall Wright-Patterson AFB, Ohio, ARL, Jan. 1965 39 p refs
(Contracts AF 33(657)-8860; AF 49(638)-792)
(ARL-65-6; AD-615385)

Studies have been made of the extent of vibrational nonequilibrium produced in supersonic expansions of undissociated N_2 from known initial equilibrium conditions attained behind reflected shock waves. The N_2 was shock heated and compressed to reservoir temperatures and pressures in the ranges 2800° to 4600° K, and 24 to 82 atm. It was then allowed to expand through a 15° axisymmetric nozzle coupled to the end of the shock tube. The extent of vibrational nonequilibrium was determined by measurements of local vibrational temperatures using the spectrum-line reversal method. The measurements showed the vibrational temperatures in the expansion flows to be much closer to equilibrium than the Landau-Teller relaxation theory predicts. Observations at two area ratios showed that the flow was not completely frozen in the vibrational sense. The probability of N_2 vibrational deexcitation inferred from these measurements is about fifteen times greater than that inferred from measurements of vibrational relaxation made behind normal shock waves. Reasons for this apparent difference are discussed in terms of the basic environmental and kinetic differences between shock-wave and nozzle-expansion flows. The validity of the application of Landau-Teller relaxation assumptions and shock-tube measured rates to predict nonequilibrium in expansion flows is thus questioned. Author

N65-35619# Polytechnic Inst. of Brooklyn, Freeport, N. Y.
COMPRESSIBLE TURBULENT BOUNDARY LAYER WITH ARBITRARY PRESSURE GRADIENT AND HEAT TRANSFER
Philip K. Sasman and Robert J. Cresci Wright-Patterson AFB, Ohio, ARL, Apr. 1965, 35 p refs
(Contract AF 33(657)-8286)
(ARL-65-65; AD-615608)

The compressible turbulent boundary layer is expressed in terms of the momentum integral and moment of momentum integral equations for arbitrary pressure gradient. Upon simplification of this equation set with a Mager type transformation, the two coupled differential equations are solved simultaneously to provide boundary layer momentum thickness, displacement thickness, skin friction coefficient and related quantities as a function of the body surface coordinate. The analysis includes surface heat transfer effects. Results of the analysis are presented for adiabatic, non-adiabatic, two-dimensional and axisymmetric flow fields in a Mach number range between 2 and 8. Flows with adverse pressure gradients are also examined. The present analysis is compared with available experimental and theoretical results. The analysis is found to yield satisfactory results for flows with and without heat transfer. Author

N65-35621# Brown Univ., Providence, R. I.
UPSTREAM FLUCTUATIONS IN FLOW IN A FORWARD STAGNATION REGION
Floyd B. Hanson and Peter D. Richardson Wright-Patterson AFB, Ohio, ARL, Apr. 1965, 17 p refs
(Contract AF 33(615)-1263)
(ARL-65-72; AD-616102)

Hot wire measurements of mean velocity and turbulent velocities were made on an upstream centerline from a 2.5 in. diameter horizontal cylinder. At .3 diameters from the stagnation point the mean velocity showed a sudden "kink" deviation from theory prediction. It took about 3 diameters for recovery to the theoretical value. The "kink" region also had peak turbulence intensity about double the expected value. The high energies in this region occurred at relatively long periods 50 to 60 m sec. Within the stagnation boundary layer the periods were 100 to 150 m sec. The "kink" region showed only very short bursts of Strouhal frequency so that a tie-up of this phenomena to wake characteristics is rather doubtful. The need for further measurements including simultaneous hot wire systems is clear. Author

N65-35640# Stanford Univ., Calif.
STUDY OF THE FLOW OF A RADIATING GAS BY A DIFFERENTIAL APPROXIMATION
Ping Cheng (Ph.D. Thesis) Jan. 1965 109 p refs
(Contract AF 49(638)-1280)
(AD-615597)

The formulation of radiating gas dynamics with the spherical-harmonic (differential) approximation appears promising. Although there is no way of ascertaining the accuracy of the approximation for multi-dimensional flow, it is extremely accurate in one-dimensional problems. In the radiation-resisted shock wave problem, Pearson's numerical solution compared well with that of Heaslet and Baldwin on the basis of the differential approximation. For the radiative transfer problem between parallel plates, Ferziger shows that the differential approximation is accurate as compared with an exact solution. The present formulation recovers the correct thin and thick gas approximations in the appropriate asymptotic situations. The facts indicate that this approach is qualitatively correct. The grey gas approximation is unrealistic from a physical point of view. This may not be critical for the linearized theory where temperature and other physical properties do not change much. The assumption of nonscattering is not essential, from the mathematical point of view, to the differential approximation. Radiative nonequilibrium effects are similar to those of chemical or vibrational nonequilibrium for radiative flow over a wavy wall. R.N.A.

N65-35673# Therm Advanced Research, Inc., Ithaca, N. Y.
ON THE HYDRODYNAMIC THEORY OF WATER-EXIT AND -ENTRY
John P. Moran Mar. 1965 130 p refs
(Contract Nonr-4438(00))
(TAR-TR-6501; AD-617517)

The mathematical theory of water-exit and -entry is critically reviewed. A detailed examination of each of the principal methods of analysis available shows that none of them yields even a uniformly valid approximation to the solution during surface crossing. It is concluded that, due to mathematical difficulties inherent in the problem, the best hope for obtaining a reliable estimate of the loads felt in crossing lies with a numerical analysis. Specific recommendations are made as to the formulation of practical numerical methods. Author

N65-35683# Electro-Optical Systems, Inc., Pasadena, Calif.
TURBULENT MIXING IN THE BASE FLOW REGION
Hartley H. King and M. Richard Denison May 1965 58 p refs
(Contract AF 04(694)-570; ARPA Order 254-62; Proj. Defender)
(EOS-RN-24; AD-617934)

An exploratory study is made in connection with the problem of predicting properties of the turbulent base flow region of a body at hypersonic speeds. An attempt is made to calculate the gross features of the base flow using a nonsimilar mixing model including the Chapman–Korst recompression condition. The expression for the eddy viscosity is based on a model which allows the turbulent equations to be transformed into incompressible laminar form. The empirical factor in the eddy viscosity expression is evaluated from data obtained from the near field (in the linear growth region) of jets exhausting into a quiescent region. The same expression

for the eddy viscosity is then used in an attempt to estimate the growth of nonsimilar turbulent mixing layer using both turbulent and laminar initial profiles. The correlation of turbulent jet mixing data for speeds up to Mach 3 shows that the eddy viscosity is a very strong function of Mach number (or of density ratio across the jet, since the data are for adiabatic flow). Author

N65-35687# New York Univ., N. Y.
THE RADIAL VARIATION OF THE EDDY VISCOSITY IN COMPRESSIBLE TURBULENT JET FLOWS Interim Report
Victor Zakkay and Egon Krause. Wright-Patterson AFB, Ohio, ARL, May 1965. 37 p. refs
(Contract AF 33(615)-1516)
(ARL-65-89; AD-617701)

The radial variation of the eddy viscosity in heterogeneous compressible turbulent jet flows is investigated. Radial distributions of ϵ/ϵ_c and $\rho\epsilon/(\rho\epsilon)_c$ are determined in the mixing region of two coaxial jets. The momentum equation is solved for the viscosity coefficient, and values thereof are obtained by using experimental velocity and concentration profiles. The turbulent Pt, Sc, and Le numbers are assumed to be unity. Three different injection gases are considered. Hydrogen, argon, and xenon are assumed to exhaust through the center jet into an air stream moving at a constant supersonic velocity. The dependence of ϵ and $\rho\epsilon$ on the velocity ratio u_j/u_e is investigated and the results are compared with the transformation suggested for the compressible eddy viscosity. Author

N65-35699# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SIMILITUDE LAWS FOR A FLOW OF GAS IN A THIN HYPERSONIC NOZZLE
Yu. L. Zhilin. 2 Jul. 1965. 11 p. refs. Transl. into ENGLISH from Inzh. Zh. (USSR), v. 3, no. 4, 1963 p 628-631
(FTD-TT-65-690/1+4; AD-617681)

A similitude law for flow of gas in a hypersonic nozzle, taking into account the interactions of the boundary layers with a potential nucleus similar to the similitude law for external flow past thin bodies established by Lunev, and Hayes and Pradstein, is obtained. Author

N65-35711# General Dynamics/Fort Worth, Tex.
A CONSISTENT-VIBRATIONS MODEL OF THE INTERNAL DYNAMICS OF LIQUID HYDROGEN Technical Report, 1 Oct. 1963–30 Sep. 1964
H. G. Carter. Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1965. 62 p. refs
(Contract AF 29(601)-6213)
(FZK-197; WL-TR-64-162; AD-614039)

A model describing the internal dynamics of a nonassociated liquid has been constructed for use in the calculation of cold-neutron scattering cross sections and free-radical recombination rates in liquid hydrogen. The proposed model assumes that the specification of a given temperature and density implies a quiescent state in which each molecule vibrates with random phase in a field set up by the sum of the position probability densities of its neighbors, the central sites of which comprise a close-packed quasi-lattice. A computer program has been written to calculate the consistent vibration frequency, the molecular well depth, the internal energy, the entropy, and the free energy of a liquid with a given temperature and density and with known Lennard-Jones parameters of the intermolecular interaction. Application of the program to the case of liquid hydrogen at points on the P-V-T surface ranging from 20° to 28° K along the saturation line has given predictions of thermodynamic properties which are in good agreement with experimental data. Author

N65-35716# Naval Ordnance Test Station, China Lake, Calif.
AN EXPERIMENTAL INVESTIGATION OF THE FLOW PHENOMENA INVOLVED IN GASEOUS THRUST DIRECTION CONTROL DEVICES
F. G. Buffum, Jr., E. W. Price, and R. O. Slates. Oct. 1964. 78 p. refs
(NAVWEPS-8615; NOTS-TP-3642; AD-614279)

The flow field involved in supersonic, jet-jet interactions as pertaining to gaseous thrust direction control devices was investigated using two-dimensional, glass-walled nozzles. The work included shadowgraph, schlieren, and pulsed laser interferometer pictures of the interaction phenomena in the vicinity of the injection port for various port positions and over a range of primary and secondary pressures. Pressure measurements for the gases examined are presented. An investigation of the extent of secondary gas penetration into the primary stream using reacting gas techniques and gas sampling methods is reported. The experimental equipment and setup for these studies is described. A phenomenological discussion of the data attempts to explain the basic mechanisms involved under various conditions. Author

N65-35733# Naval Weapons Lab., Dahlgren, Va.
SOME RECENT DEVELOPMENTS IN THE THEORY OF VISCOUS FLUID FLOW WITH TECHNOLOGICAL AND GEOPHYSICAL APPLICATIONS
Ernst W. Schwiderski and Hans J. Lugt. Apr. 1965. 80 p. refs
(NWL-1963; AD-614429)

Three general mathematical techniques, which have been introduced for systematic solution of the Navier–Stokes equations of incompressible viscous fluid flow, are briefly reviewed. In particular, the applications of these methods to various fundamental flow problems of theoretical and technological interest are highlighted and analyzed with respect to the major physical features of realistic small-scale and large-scale fluid motions. A complete bibliography of all original papers published or in publication, which contain all detailed derivations and results, is given. Author

N65-35739# Princeton Univ., N. J. Dept. of Aeronautical Engineering.
THEORIES OF THERMAL TRANSPIRATION AND MOLECULAR EFFUSION
Yau Wu. Feb. 1965. 28 p. refs. *Its* Rept.-718
(Contract AF 49(638)-1271; Grant NSF-GK-59)
(AFOSR-65-0645; AD-616285)

The revised theories of thermal transpiration and molecular effusion have been presented in a rigorous treatment. It is a modified version of the classical laws of Reynolds and Graham. A set of invariants and a new geometrical property (isotropicity) have been found in a system with nonuniform temperature distribution on the boundary in the Knudsen regime. The reciprocal transmission probability theorem has been proved to be valid in this stationary state system according to the invariant of number flux throughout the region. Author

N65-35757# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.
CONDENSATION OF CARBON DIOXIDE IN SUPERSONIC NOZZLES

Karl M. Duff Sep. 1964 39 p refs
(Contract Nonr-3963(07))
(Rept.-76; AD-608161)

Condensation of CO_2 in a supersonic nozzle is investigated. Descriptions of test apparatus and nozzle are presented along with data and plotted pressure profiles for both condensing and non-condensing CO_2. Limited comparison of theoretical and experimental methods is inconclusive, but suggests that the homogeneous nucleation theory is valid for the condensation of CO_2. Limited results of density measurements by means of the interferometer are presented and the difficulties encountered in employing this instrument are discussed. Finally, recommendations for resolving these difficulties and for further efforts in this investigation are suggested. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-34772# Naval Ordnance Lab., White Oak, Md. Physics Research Dept.

A METHOD OF AIRBORNE BOTTOM-REFLECTIVITY SURVEYING

R. J. Urick, C. E. Kelly, and M. H. Stripling Aug. 1965 26 p Presented at 2d Symp. on Mil. Oceanog., Washington, May 1965 (NOLTR-65-90; AD-619026)

This is a feasibility study of a method of measuring underwater sound parameters by means of explosive sound signals and sonobuoys dropped from aircraft. By eliminating the need for surface ships in this form of oceanography, the method has obvious advantages in mobility and rapidity for measurements and surveys in inaccessible areas and where large areal coverage is required. Author

N65-34779 Joint Publications Research Service, Washington, D. C.

DETERMINATION OF SECOND ORDER CORRECTION TERM IN MEASUREMENT OF GRAVITY AT SEA

Hsi-ch'i Li *In its* Transl. on Communist China's Sci. and Tech. 13 Sep. 1965 p 1-10 refs Transl. into ENGLISH from Ts'e-liang Chi Ti-ch'iu Wu-li Chi-k'an (Peking), no. 1, Feb. 1965 p 12-18 (See N65-34778 23-34) CFSTI: $2.00

Gravimetric measurements at sea by long period- and short period pendulums, and their corresponding corrections for inclination and horizontal acceleration were analyzed by trigonometric approximations. It was found that the long period pendulum alone can be used for second order corrections if the damping torque is proportional to the angular speed of the gravity meter pendulum. The long period pendulum can be hung at any location on the level frame, but the center of oscillation of the short period pendulum and the axis of its level frame must be on the same level. G.G.

N65-34805 Naval Ordnance Test Station, China Lake, Calif.

TETHERED AEROLOGICAL BALLOON SYSTEM

Shelden D. Elliott, Jr. *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 1-26 (See N65-34804 23-20)

The Tethered Aerological Balloon System (TABS) currently under development at NOTS is designed to maintain a captive balloon and payload at stratospheric altitudes for an indefinite period of time, taking advantage of the region of minimum wind velocity nearly always present at some level in the lower stratosphere. The system consists of: (1) a conventional polyethylene balloon fitted with a self-deploying reefing system to reduce lateral drag; (2) an airborne telemetry/command package capable of monitoring up to six aerological or other parameters concurrently; additional packages may be distributed along the tether as needed; (3) a NOTS-developed glass fiber tether having a tensile strength comparable to that of steel, at one-fourth the weight of steel, fabricated in splice-free lengths exceeding 100 000 feet; and (4) a mobile ground vehicle from which all functions subsequent to launch can be performed, carrying a crew, control winch, and equipment to communicate with a ground telemetry and command station; the vehicle can run with the wind to reduce lateral drag loads on ascent or descent. The system is expected to become operational this fall (1964). Various uses and possible further developments of such a stratospheric moored platform are discussed, including applications to manned systems. Author

N65-34818 Air Force Cambridge Research Labs., Bedford, Mass.

TEMPERATURE MEASUREMENTS FROM FLOATING BALLOONS

W. C. Wagner *In its* Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 157-168 (See N65-34804 23-20)

Problems and methods of measuring ambient air temperature from floating balloons are discussed. The main problems are the change in air temperature caused by heat exchange with the balloon, and the heat exchange of the sensor with air and the radiation field. Balloon heat exchange with the air is dependent on balloon dimensions, material, and movement, and on the radiation field. Polyethylene balloons have smaller temperature differences with the air due to their lower absorption coefficient in the infrared, and their wake is shorter and not too strong. Immersion sensors are the most suitable for temperature measurements from floating balloons. The heat exchange of this sensor with the air and the radiation field is discussed. The immersion sensor can achieve an accuracy of 1° C over the entire altitude range of balloon operations. However, to improve this accuracy requires special care with the quality of the sensor coating and the dimensions of its holder. To obtain any accuracy, it is absolutely necessary to mount the sensor so that it is out of the balloon wake and out of the boundary layer of any structure. R.N.A.

N65-34827 Michigan Univ., Ann Arbor. MTI Radar Lab.

ACOUSTIC DETECTION OF HIGH-ALTITUDE TURBULENCE

John W. Wescott *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 295-316 (See N65-34804 23-20)

The causes of low-frequency acoustic background noise that was monitored from instrumented balloons floating at about 60 000 feet were investigated. Tape-recorded samples of the noise were analyzed. Spectrograms, signatures, cross-correlations and probability-density curves were obtained. Examples are shown. The results indicate that clear-air turbulence is one of the principal sources of infrasound in the upper air. A theory for the power spectrum of the far-field noise radiated from the turbulence is cited, and the predicted spectrum is compared to experimental results. Author

N65-34833 National Center for Atmospheric Research, Boulder, Colo.

COSMIC RAY BALLOON EXPEDITION TO INDIA, IQSY-EQEX

R. Kubara and B. Stiller (Naval Res. Lab., Washington) *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 393–397 (See N65-34804 23-20)

Plans to send a balloon expedition to India for cosmic radiation study in the vicinity of the equator during the International Quiet Sun Year are discussed. The mission purpose is to obtain cosmic ray data near the earth's geomagnetic equator at higher altitudes than previously attained. Sixteen flights will be flown; all of them are planned to reach at least 120 000 feet and to stay at floating altitude for at least eight hours. Stratofilm was chosen as the balloon material due to its demonstrated resistance to low temperatures in the stratosphere; data on eight flights by Stratofilm balloons during Project Coldtrop are presented. J.M.D.

N65-34841# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT AURORA III. Final Report, 12 Feb.–15 Jun. 1965
Walter A. Flood Bedford, Mass., AFCRL, 15 Jun. 1965 35 p refs
(Contract AF 19(628)-380)
(CAL-CM-1677-P-1; AFCRL-65-451; AD-619447)

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1. SOME EVIDENCE FOR THE OCCURRENCE OF HIGH ELECTRON DENSITIES IN THE AURORAL D AND E REGION 21 p refs (See N65-34842 23-13)
2. AN ANALYSIS OF THE STATISTICS OF SIMULTANEOUS AURORAL ECHOES 11 p refs (See N65-34843 23-13)

N65-34842 Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT AURORA III. PART I: SOME EVIDENCE FOR THE OCCURRENCE OF HIGH ELECTRON DENSITIES IN THE AURORAL D AND E REGION
In its Proj. Aurora III 15 Jun. 1965 21 p refs (See N65-34841 23-13)

A-scope photographs of simultaneous auroral echoes at 49.7, 143.5 and 226 Mcs using scaled antenna systems with five degree beamwidths are presented and are discussed. The photographs clearly show that on occasion the 49.7 and 143.5 Mcs echoes can arise at disparate ranges. These photographs are interpreted as indicating the presence of local electron densities (occupying regions which subtend angles smaller than five degree system beamwidth) in excess of 2×10^7 electrons/cm^3. Consequently single scatter theory cannot always be applied to the analysis of auroral echoes at frequencies as low as 50 Mcs. Author

N65-34843 Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT AURORA III. PART II: AN ANALYSIS OF THE STATISTICS OF SIMULTANEOUS AURORAL ECHOES
In its Proj. Aurora III 15 Jun. 1965 11 p refs (See N65-34841 23-13)

The amplitude distribution and wavelength dependence of simultaneous auroral echoes at 49.7, 143.5 and 226 Mcs have been studied. Amplitude distributions are very closely Rayleigh distributed. The data are interpreted as indicating a wavelength dependence which varies as $\lambda^{3.5}$ for frequencies between 50 Mcs and 143.5 Mcs and $\lambda^{6.5}$ for frequencies between 143.5 and 226 Mcs. During conditions of strong auroral activity, auroral absorption may tend to mask the wavelength dependence at the two lower frequencies. Author

N65-34871# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
AN EXPERIMENTAL OBJECTIVE ANALYSIS IN THE TROPICS Technical Paper No. 62
Michio Yanai Oct. 1964 28 p refs
(AD-619188)

A version of the correction objective map analysis scheme has been developed and tested for the surface meteorological elements and the upper-air winds in the Caribbean region. However, in order to overcome the difficulty of getting reasonable analysis over the oceanic area devoid of data, a successive vertical differential analysis technique has been employed for the upper wind analysis. Surface map analysis serves to obtain a reliable base for the upper wind analysis. Some technical problems in handling operational data are mentioned. In upper wind analysis, special caution is needed to insure a reasonable analysis over wide open areas without stations. It has been found that the correction method tends to build a peculiar distortion of analyzed pattern in these areas. A simple method to detect the possible distortion is analyses of latitudinal and longitudinal coordinates from latitude and longitude data at the observation stations only. The results based on the experimental computations are illustrated with charts and discussed with some statistical results. Author

N65-34882# Naval Postgraduate School, Monterey, Calif.
AN EVALUATION OF THE U.S. NAVY STRATOSPHERIC EXTRAPOLATION EQUATIONS AND AN INTERCOMPARISON OF SEVERAL METHODS OF 100, 50 AND 30-mb ANALYSES
Richard C. Carrigan and Richard J. Pagnillo (M.S. Thesis) 1965 90 p refs
(AD-619196)

In 1960 the United States Navy Weather Research Facility, Norfolk, Virginia, (NWRF) derived a set of linear regression equations having as their purpose to extrapolate vertically height and temperature data up to the 100-, 50-, and 30-mb levels. The equations are statistically evaluated, particularly for the latitude band 30–40 degrees, with a view toward improving their usage in objective analysis by the United States Navy Fleet Numerical Weather Facility, Monterey, California (FNWF). It is found that the equations' usefulness depends on the "normality" of the synoptic situation, but in general the subject re-evaluation agrees well with tests conducted by NWRF for previous years. An intercomparison of stratospheric analyses at 100-, 50-, and 30-mb, indicates the necessity of actual stratospheric data (not just regression equations) for analysis at polar latitudes. Several schemes for objective stratospheric analysis, involving minimal use of data, are suggested by the authors. Author

N65-34885# United ElectroDynamics, Inc., Alexandria, Va. Earth Sciences Div.
SYNTHETIC EARTHQUAKE SEISMOGRAMS FOR TELESEISMIC DISTANCES Seismic Data Laboratory Report No. 104
Robert Van Nostrand 14 May 1964 25 p ref
(Contract AF 33(657)-12447; Proj. Vela uniform)
(AD-600103) CFSTI: $0.75

The purpose of this study was to test the hypothesis that the initial train of P-waves on seismograms recorded at teleseismic distances is more complicated for earthquakes occurring in the crust than for explosions near the earth's surface. Both pure compressional and pure shear sources, and some combination sources, were assumed in separate computations.

"Spike" seismograms were first constructed and then convolved with an assumed source signal to obtain the complete synthetic seismogram. It was shown, as expected, that a buried source produces more multiply-reflected waves than does a surface source; in turn, other things being equal, an SV-source yields more than a P-source. Only the first surface-reflected multiple exhibits an amplitude comparable to that of the primary wave. Author

N65-34897# Illinois Univ., Urbana. Electrical Engineering Research Lab.
IONOSPHERIC RESEARCH Sixth Quarterly Progress Report, 1 Jan.–31 Mar. 1965
H. D. Webb [1965] 66 p refs
(Contract DA-36-039-AMC-03703(E))
(Rept.-6; AD-618708)

Moon reflected signals were received on 46 days during the quarter, for 382 hours at 150.6 mc. Signals at 413.25 mc were also received during 44 of the observations days, so that the total Faraday rotation angle could be resolved on those days. Diurnal average curves for observation periods in September, October, November and December, 1964, are presented. A study dealing with the correlation of electron content irregularities and irregularities in the horizontal component of the earth's magnetic field is nearing completion. Using quantitative data from correlated irregularities, velocities of motion of ionospheric disturbances have been calculated which fit a 12-hour cycle. A thesis dealing with a comparison of methods of resolving the n × 180° ambiguity of the Faraday rotation angle is presented. Author

N65-34900*# Mellon Inst., Pittsburgh, Pa.
SPECULATIONS ABOUT PLESSITE
T. B. Nassalski, F. R. Park, and L. F. Vassamillet 1965 27 p refs
(Grant NsG-668)
(NASA-CR-67180) CFSTI: HC $2.00/MF $0.50 CSCL 03B

Samples of Canyon Diablo, Bristol, Bethany, and Toluca meteorites were prepared for metallographic examination and microprobe analysis, and simultaneous Ni and Fe concentration profiles were measured. Only Ni concentrations are presently reported, and the operating conditions are listed. The examination of dark etching plessitic areas (decomposed areas) in the meteorites shows that several distinct regions can be identified. Photographs of such magnified areas are given. Present evidence indicates that in the majority of cases where the Ni concentration in the M profile does not rise above 25%, martensitic decomposition occurred and was followed by decomposition in $\alpha + \gamma$ structures. In the majority of cases where plessite is examined in detail, there are indications that its formation is intimately related to the formation of martensite during the cooling history. Other theories on meteorite history are also discussed. L.S.

N65-34935 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DYNAMICS OF THE GEOMAGNETIC TRAP
V. D. Pletnev, G. A. Skuridin, and L. S. Chesalin *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 104–135 refs (See N65-34925 23-30)

Examined are the basic experimental data and theoretical concepts pertaining to geophysical phenomena occurring in the near-earth region of outer space. It is demonstrated that such phenomena as magnetic storms, polar aurorae, the radiation belts and the confined magnetosphere of the earth should be studied from a single standpoint, since they are closely interrelated. The authors refer to the complex of these geophysical phenomena as the dynamics of the geomagnetic trap. This paper is devoted to an examination of experimental data and certain problems of a general theoretical nature, associated with the dynamics of the geomagnetic trap. Author

N65-34936 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECTS OF THE AMERICAN HIGH-ALTITUDE EXPLOSION OF 9 JULY 1962 IN THE UPPER ATMOSPHERE
Yu. I. Gal'Perin *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 136–148 refs (See N65-34925 23-30)

Satellite measurements obtained during the early stages of the existence of an artificial radiation belt, and later measurements of the intensities and rates of decrease were analyzed. From these results, the distribution of intensities for the hard electrons injected into the magnetosphere during the explosion were reconstructed to $L \sim 2.3$. The integration of this distribution with respect to volume shows that the total quantity of injected electrons captured in the belt during the first hour after the explosion, exhibiting an invariant coordinate $h_{min} \geq 300$ km, amounted to about $1.5 \cdot 10^{25}$; the number of electrons with energies of $E \geq 1.5$ MeV was $4 \cdot 10^{24}$. Calculations indicate that within three seconds after the explosion, the fragements of approximately 10^{25} fissions appeared at altitudes of ≥ 1200 km, and the γ and β emissions respectively produced a γ pulse and an artificial belt of hard electrons. M.G.J.

N65-34937 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL CHARACTERISTICS OF FIELDS OF RECEIVING RADIATION ON THE BASIS OF DATA PROVIDED BY THE TIROS-II AND TIROS-III ARTIFICIAL SATELLITES OF THE EARTH AND THE INTERPRETATION OF THESE DATA
Ye. P. Borisenkov, Yu. P. Doronin, and K. Ya. Kondrat'yev *In its* Cosmic Res., Vol. 3, No. 3, 18 Aug. 1965 p 149–169 refs (See N65-34925 23-30)

Considered are the basic possibilities of using statistical methods of analyzing data on the measurement of receding radiation with weather satellites. The proposed method of statistical analysis is tested on an example using the data of the American weather satellites. Fundamental quantitative statistical characteristics of the terrestrial radiation field have been obtained and are analyzed. The data on these characteristics have been used for the solution of several applied problems (determination of optimum measurement frequency, etc.). Author

N65-34938 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF VERTICAL TEMPERATURE PROFILE OF THE ATMOSPHERE FROM OUTGOING RADIATION IN THE CO_2 ABSORPTION BAND
M. S. Malkevich and V. I. Tatarskiy *In its* Cosmic Res., Vol. 3, No. 3, 18 Aug. 1965 p 170–190 refs (See N65-34925 23-30)

A method is proposed for determining the temperature profile of the atmosphere from measurements of outgoing radiation in the CO_2 absorption band. The proposed method is based on the use of an expansion of the sought temperature profile in a statistically orthogonal system of temperature-field functions, which, for a given accuracy of approximation, enables us to minimize the number of terms in the expansion and reduce the influence of instability in solving the inverse problem. The paper presents the results of a numerical

experiment, which illustrate the error of the temperature-profile determination and the influence of measurement errors upon it. Author

N65-34939 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRELIMINARY RESULTS OF DETERMINATION OF PARTICLE CONCENTRATION AND DENSITY OF THE ATMOSPHERE OF 18 JUNE 1963

V. V. Mikhnevich, Ye. N. Golubev, and Yu. N. Parfianovich *In its* Cosmic Res., Vol. 3, No. 3, 18 Aug. 1965 p 191–207 refs (See N65-34925 23-30)

Ionization and magnetic electrical discharge manometers, installed on a high altitude automatic geophysical station, were used to determine atmospheric density and particle concentration at altitudes of 120 to 360 km. A block diagram of the manometric apparatus is included, and the method of experiment is described. Data indicate a correlation between atmospheric density and solar activity at altitudes above 200 km, with the density diminishing concurrently with the drop in solar activity. It was also concluded that the influence of solar activity on atmospheric density below 200 km is insignificant. M.G.J.

N65-34940 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLUCTUATIONS OF ATMOSPHERE DENSITY IN 1960–1963, OBTAINED FROM CHANGES IN ORBITS OF ARTIFICIAL EARTH SATELLITES

N. P. Slovokhotova *In its* Cosmic Res., Vol. 3, No. 3, 18 Aug. 1965 p 208–214 refs (See N65-34925 23-30)

The diurnal fluctuations of atmospheric density were investigated at altitudes of 200–300 km on the basis of the results of reduction of observations of Soviet artificial earth satellites during 1960–1963. The studies confirmed the presence of diurnal density variations at these altitudes during a period near the solar activity minimum (1962–1963). As a result of the diurnal effect, the density at an altitude of 300 km varies over a factor of 2, but by 10–20% at an altitude of 200 km. At an altitude of about 300 km, a moderate (or the order of 20%) drop in density was noted (both at night and during the daytime) from 1960 to 1962. Author

N65-35063*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE DETERMINATION OF PRESSURE AND DENSITY PROFILES FROM TEMPERATURE PROFILES IN THE ATMOSPHERE

J. S. Theon and W. Nordberg Washington, NASA, Oct. 1965 11 p refs

(NASA-TN-D-3009) CFSTI: HC $1.00/MF $0.50 CSCL 04B

The rocket grenade technique for measuring meteorological parameters in the upper atmosphere produces direct observations of temperature and wind only. Pressure and density profiles must be computed from well-known physical considerations by one of several analytical methods. Similar considerations apply to two other techniques, the falling sphere and the pitot-static tube experiments, in which density is the measured parameter and temperature and pressure must be derived. Basically, all of the analytical methods employ the hydrostatic equation and perfect gas law to relate temperature or density to pressure. Obviously, it is desirable to employ the one method which produces the most accurate results. Each method is presented and the effect of errors in the initial pressure or temperature assumption is discussed. A comparison of pitot-static tube data and rocket-grenade data is made for experiments launched almost simultaneously. Author

N65-35073*# National Aeronautics and Space Administration, Washington, D. C.

THE EFFECT OF PRESSURE ON THE MASS TRANSFER BETWEEN MAGMATIC MELT AND WATER OF THE EXTERNAL MEDIUM [VLIYANIYE DAVLENIYA NA MASSOBMEN MEZHDU MAGMATICHESKIMI RASPLAVAMI I VODOY VNESHNEY SREDY]

A. A. Kadik and N. I. Khitarov Sep. 1965 24 p refs Transl. into ENGLISH from Geokhimiya (Moscow), no. 5, 1965 p 507–517

(NASA-TT-F-9556) CFSTI: HC $1.00/MF $0.50 CSCL 08D

An estimate is given on the influence of water pressure in magma pores, hydrostatic pressure exerted on the melts, and water content in the melt itself on the mass transfer between magmatic melts and water of the external medium. A simple binary system of a volatile component and a silicate melt in equilibrium is used as physical model in deriving equations for calculating the equilibrium of the albite–water system, taking the osmotic effect and the influence of gravitation into consideration. An increase in water vapor pressure increases the equilibrium concentration of water while an increase in the pressure of the overlying liquid column decreases this equilibrium. Apparently, the magma absorbs water in its lower layers and gives off water near the roof of the magma chamber, promoted by convection in the melt and diffusion toward the top. Author

N65-35079# California Univ., Los Angeles. Dept. of Meteorology.

THE STRUCTURE OF THERMAL CONVECTION IN THE LOWER ATMOSPHERE Final Report, Part II

Leonard O. Myrup Feb. 1965 84 p refs

(Contracts OCD-OS-62-143, OCD-PS-64-24)

(AD-619268)

An experimental study of atmospheric convection under conditions of strong surface heating and light winds is presented. Using an instrumented light aircraft, measurements were made of the fluctuating temperatures and vertical air speeds over a desert dry lake during the daytime. The instrumentation system and data reduction procedures are described, with particular emphasis on solving the problem of determining a frame of reference for a moving instrument platform. The airplane measurements showed the variation with height of the root-mean-square temperature fluctuations, and the root-mean-square vertical velocity fluctuations agreed with the similarity theory predictions out to the most extreme stabilities included in the data. The free convection problem is surveyed, along with the atmospheric and laboratory measurements pertaining to the similarity predictions. The findings are related to theoretical and laboratory results, and areas of agreement and disagreement are delineated. M.G.J.

N65-35166# RAND Corp., Santa Monica, Calif.

ON THE SMALL AMPLITUDE OF MAGNETIC SECULAR CHANGE IN THE PACIFIC AREA

E. H. Vestine and A. B. Kahle Aug. 1965 12 p refs Submitted for Publication

(P-3215)

It has been suggested that toroidal fields in the earth's fluid metallic core are brought to the surface to provide changes with time in the geomagnetic field. The centers of secular change thereby produced then drift slowly westward. If there is a downflow of fluid the secular change pattern may then be reduced in intensity relative to those regions experiencing an upflow. Data on the geomagnetic field (1912–1955) are used to show that such a downflow is probable in the Pacific region. This may provide an unforced explanation for the small amplitude in secular change long observed in the Pacific. Author

N65-35169# Liege Univ. (Belgium). Institut D'Astrophysique.
ON THE APPLICATION OF CURTIS-GODSON'S APPROXIMATION TO THE 9.6 μ BAND OF ATMOSPHERIC OZONE Technical Note No. 1
M. Mayot and E. Vigroux 31 Jan. 1965 56 p refs
(Contract AF 61(052)-685)
(AFCRL-65-265; AD-618910)

A critical study of the Curtis-Godson approximation is applied to the present interpretation of the observations of the atmospheric ozone in the infrared region. Corrections are computed to account for the different conditions in laboratory experiments and observations through the atmosphere. Also, a comparison is made between theoretical results and the observational data and factual conclusions are presented. E.E.B.

N65-35177# Centre National de Recherches de .l'Espace, Brussels (Belgium).
EFFECT OF THE VELOCITY OF A FALLING BODY ON THE MEASUREMENT OF THE WIND IN THE UPPER STRATOSPHERE AND THE MESOSPHERE [EFFET DE LA VITESSE DE CHUTE D'UN MOBILE SUR LES MESURES DU VENT DANS LA STRATOSPHERE SUPERIEURE ET LA MESOSPHERE]
L. M. Malet Aug. 1963 22 p refs In FRENCH Submitted for Publication *Its* Notes Preliminaires No. 31 CFSTI: HC $1.00/MF $0.50

A derivation of motion equations which describe the effect of the velocity of a falling body upon the measurement of the wind in the upper atmosphere is given. An evaluation is made of the error affecting the direction of the wind due to the velocity of the falling body, and a discussion concerning the application of the correction formulas is included. Data are presented in tabular form summarizing experiments with the free fall of sphere and parachute bodies. Transl. by G.A.L.

N65-35178# Royal Inst. of Tech., Stockholm (Sweden).
ON THE DISTRIBUTION OF ELECTRIC FIELDS IN THE MAGNETOSPHERE
Lars P. Block [1965] 29 p refs Submitted for Publication (Rept.-65-10) CFSTI: HC $2.00/MF $0.50

The distribution of electric fields in the magnetosphere was studied by formulation of a mathematical model that assumed the injection of a plasma with continuous energy spectrum into the magnetosphere. It was shown that space charges will occur due to the different forbidden regions for particles of different charge and energy. The space charges will tend to suppress the applied potential and push the field towards the outer parts of the magnetosphere leaving a fieldfree region in the center. This fieldfree region may be identified with the region containing the Whistler medium. Outside of the region, the thermal plasma is swept away by the electric fields. In a first tentative approximation the auroral zone was found to be situated at an L-value, which is 52% larger than the L-value of the fieldfree boundary. G.G.

N65-35220*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UPPER ATMOSPHERE COMPOSITION DATA FROM EXPLORER XVII
Carl Reber [1964] 41 p refs Submitted for Publication (NASA-TM-X-51836) CFSTI: HC $2.00/MF $0.50 CSCL 04A

The Explorer XVII aeronomy satellite carried two double focusing magnetic mass spectrometers designed to measure the concentrations of the major neutral particle constituents of the earth's upper atmosphere. The ambient densities of helium, oxygen, and nitrogen were obtained between north and south latitudes of 58 degrees, and from the perigee altitude of 257 kilometers to an altitude in excess of 700 kilometers. Data for various local times, altitudes, and geographic locations were combined to provide a broader altitude coverage than experienced at any single location. Atmospheric density from density gauges was compared with satellite drag data. Electrostatic probes also were used, and the measurements of T_e and N_i in the F_2 region above Blossom Point showed that thermal nonequilibrium ($T_e > T_g$) was the normal condition night and day and the degree of nonequilibrium was strongly latitude dependent in the daytime and moderately variable at night. R.W.H.

N65-35230*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
THE LATITUDINAL DISTRIBUTION OF CLOUD COVER FROM TIROS III PHOTOGRAPHS
Albert Arking [1964] 19 p refs Submitted for Publication (NASA-TM-X-51611) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Television pictures from the Tiros III satellite have been analyzed on a computer to give the latitudinal distribution of cloud cover during the summer of 1961. The results, which will be useful in studying the heat balance of the atmosphere, and in the determination of vertical motion, show good agreement with the long term average cloudiness derived from data accumulated during a half century of ground observations. Author

N65-35266*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE TEMPERATURE OF CHARGED PARTICLES IN THE UPPER ATMOSPHERE
R. E. Bourdeau May 1964 26 p refs Presented at COSPAR Meeting, Florence, Italy, 8–20 May 1964 Submitted for Publication
(NASA-TM-X-51863; X-615-64-103) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Three general methods used to investigate charge particle temperatures in the upper atmosphere include direct measurements from rockets and satellites, indirect determination using electron scale heights measured from rockets and satellites, and ground based radar incoherent backscatter experiments. The latitude and temporal trends of these results are reviewed and the implications discussed. All three methods show that the electron temperature increases with latitude for both daytime and nighttime conditions. Differences between daytime electron and neutral gas temperatures are moderate to altitudes above the F2 peak for a winter midlatitude ionosphere at an epoch between solar maximum and minimum conditions. Larger daytime differences are observed for summer months and for solar minimum conditions. These trends reflect corresponding changes in electron density. Daytime observations are consistent with ultraviolet radiation as the main heat source if the possibility of photoelectrons diffusing along magnetic field lines and depositing their excess energy elsewhere is included. A nighttime heat source small compared to the daytime ultraviolet effect is required to explain the observations. R.N.A.

N65-35292# Massachusetts Inst. of Tech., Cambridge.
SAMPLING EVENTS FROM U.S.C. AND G.S. EARTHQUAKE CARDS Scientific Report No. 11 (Final), 1 Apr.–15 Jun. 1965
Stephen M. Simpson, Jr., Ralph A. Wiggins, and Cheh Pan 30 Jun. 1965 75 p
(Contract AF 19(604)-7378; ARPA Order 180-61; Proj. Vela Uniform)
(AFCRL-65-463; AD-618209)

Two computer programs are presented and illustrated for statistical selection of events from magnetic tapes containing images of U.S. Coast & Geodetic Survey Earthquake Cards. The first program produces an output tape containing cards for all events within a given time range, depth range, and geographical area. The area is specified by arbitrary sets of trapezoids whose parallel sides are latitude lines. Three major seismic regionalizations have been card coded into such sets. The second program selects, from the output tape of the first program, all events in given magnitude ranges. It then shuffles the events using the Rand random digits and deals out a selected number of them. Author

N65-35309*# Princeton Univ., N. J. Dept. of Geology
EQUILIBRIUM CONFIGURATIONS BETWEEN DENSITY AND TOPOGRAPHIC SURFACE IRREGULARITIES IN A PURELY ELASTIC EARTH MODEL Technical Report No. 2
Bernard R. Durney 1 Oct. 1964 12 p ref
(Grant NsG-556)
(NASA-CR-59233) CFSTI: HC $1.00/MF $0.50 CSCL 08B

A two-dimensional purely elastic earth model is used to study elastic equilibrium configurations between density and topographic surface irregularities (mountains). Given a density deficiency $\delta\rho(x,y)$ the shape of the mountain in equilibrium with $\delta\rho(x,y)$ is determined by specifying that the vertical displacements due both to the mountain and $\delta\rho(x,y)$ vanish at the surface. The compression due to density irregularities is evaluated and numerical examples are given. Author

N65-35329# Weapons Research Establishment (Australia).
BASIC ATMOSPHERIC PARAMETERS AS MEASURED BY FOUR FALLING SPHERE EXPERIMENTS AT WOOMERA APRIL–JULY 1964
P. H. O. Pearson and R. J. Curnow Jan. 1965 56 p refs
(WRE-PAD-81) CFSTI: HC $3.00/MF $0.50

Four falling sphere experiments were conducted to measure atmospheric density, temperature, pressure, and winds. These results, and an additional wind result, are presented together with a discussion of the extension of the horizontal wind results from 200 000 to 260 000 ft. These results are concerned with the seasonal variations shortly after dusk. Author

N65-35344# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
NUMERICAL ANALYSIS OF TIROS RADIATION OBSERVATIONS Technical Paper No. 67
Ferdinand Baer and William Kamm Jun. 1965 26 p refs
(Contract DA-28-043-AMC-01303(E))
(AD-619192)

TIROS III radiation measurements are taken from binary tape, selected for a given geographic region, accepted under satisfactory model conditions and interpolated to points for which no fix is given. These raw data are then fit to a uniformly spaced set of grid points covering the region of interest. The fitting procedure is either a least squares polynomial fit or a weight function fit, the choice depending on the nature of the data in the influence region about the grid point. A sample analysis and statistical information on data distribution are presented to suggest the effectiveness of the analysis procedure to the type of data under consideration. Author

N65-35347# RAND Corp., Santa Monica, Calif.
ON THE EFFECTS OF STRESS-WAVE DIFFRACTION ON GROUND SHOCK MEASUREMENTS: PART II
C. C. Mow and T. Repnau Aug. 1965 54 p ref
(Contract AF 49(638)-700; Proj. RAND)
(RM-4556-PR; AD-619276)

For a better understanding of the stress-wave diffraction that occurs at the boundary of an inclusion embedded in an elastic medium, a parametric study was undertaken, with the errors in the shock measurements determined as a function of the parameters. Numerical results indicate that for a simple type of decaying incident shock, the maximum velocity and acceleration responses are dependent upon the ratio of the medium and inclusion densities, and to a lesser degree on the Poisson ratio of the medium. Also investigated are some special instances when poles in the admittance function are of order 2 instead of just simple poles; the indicial admittance function for determining the response of the inclusion for an arbitrary free-field motion; and a method for determining free-field motion from the motion of the inclusion. The solutions given are expressed in dimensionless form; and are equally applicable to displacement and acceleration because of the identity of the admittance functions for displacement, velocity, and acceleration responses. The parameter used to nondimensionalize time is the half-transit time. M.G.J.

N65-35471# Kiruna Geophysical Observatory (Sweden).
PLASMA WAVES IN THE FREQUENCY RANGE 0.001–10 CPS IN THE EARTH'S MAGNETOSPHERE AND IONOSPHERE Final Report
Bengt Hultqvist Jun. 1965 140 p
(Contract AF 61(052)-619)
(AFCRL-65-683; AD-622223) CFSTI: HC $4.00/MF $1.00

The plasma model for the magnetosphere and ionosphere is first discussed. A review of some parts of the theory for a warm collisionless plasma of interest in the magnetosphere in connection with waves of periods between 0.1 and 1000 seconds is given. The theory for magnetohydrodynamic waves in a slightly ionized gas is then summarized. The available observational data about magnetospheric and ionospheric phenomena, which may be interpreted in terms of waves with periods between 0.1 and 1000 seconds, are briefly surveyed and some theoretical applications to the ionosphere and magnetosphere are finally discussed. Most of the report is devoted to warm-plasma theory. The theory of shock phenomena and transients in the magnetosphere is not included in the report. Author

N65-35515# Centre National de la Recherches de l'Espace, Brussels (Belgium).
IONIZED MEDIUM OF THE TERRESTRIAL ATMOSPHERE [LE MILIEU IONISE DE L'ATMOSPHERE TERRESTRE]
M. Nicolet Dec. 1964 31 p In FRENCH Presented at the Intern. Astronautical Federation, Warsaw, Sep. 1964 CFSTI: HC $1.00/MF $0.50

A discussion and diagrams concerning the conditions of the ionized terrestrial ionosphere are presented. Topics considered include: the number and density of cosmic rays, solar radiation, electron diffusion and concentration in the ionosphere, the interaction between the ionosphere and the exosphere, and charged particles within the magnetosphere. Transl. by G.A.L.

N65-35544# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
SEASONAL ATMOSPHERIC ATTENUATION MEASUREMENTS AT 3.27 cm WAVELENGTH Environmental Research Papers No. 115
John P. Castelli Jun. 1965 26 p refs
(AFCRL-65-47; AD-619172)

Atmospheric attenuation measurements have been made for four seasons during 1962 and 1963 at Sagamore Hill, Hamilton, Massachusetts, at a wavelength of 3.27 cm. A definite seasonal trend was noted with the greatest attenuation observed during the winter when an average vertical attenuation of 0.13 db was measured. The trend seems to be well correlated with seasonal averages of surface barometric pressure. Summer attenuation in 1964 is compared with similar measurements made in 1946 in the same geographical area. Author

N65-35579*# Stanford Research Inst., Menlo Park, Calif.
VLF PROPAGATION AND NOISE IN THE IONOSPHERE OBSERVED BY SOUNDING ROCKETS Final Report
L. E. Orsak, L. H. Rorden, G. B. Carpenter, and B. P. Ficklin Jan. 1965 217 p refs
(Contract NASr-49(01))
(NASA-CR-67376) CFSTI: HC $6.00/MF $1.25 CSCL 04A

Data obtained from two instrumented payloads flown aboard two Aerobee rockets are summarized, and analyses are presented on the phenomena observed. Although designed primarily to explore the effects of the lower ionosphere on VLF waves, various independent experiments were flown on each flight, and launchings were made at noon and at two hours before midnight to obtain representative samples of the daytime and nighttime ionosphere, and signal sources. Attenuation profiles were obtained on both flights by narrow-band sweeping receivers for signals, manmade as well as natural, in the 0.2 to 100 kc, and 1250 to 1600 kc frequency ranges; a broadband receiver (0.3 to 12.5 kc) obtained data on many whistler-type signals, including the subprotonospheric whistler. Details of the instrumentation, and the results of each experiment are included. M.G.J.

N65-35581*# HRB-Singer Inc., State College, Pa.
PRE-SUNRISE CHANGES IN VLF RADIO WAVES IONOSPHERICALLY REFLECTED NEAR VERTICAL INCIDENCE
J. M. Musser and C. F. Sechrist, Jr. Jun. 1965 110 p refs
Its Rept.-770-R-1
(Contract NASw-1109)
(NASA-CR-67375) CSCL 04A

This report describes the results of steep-incidence VLF measurements conducted at Wallops Island, Virginia, which complemented D-region rocket experiments carried out by the University of Illinois. The VLF data reveal indirectly the variability of non-deviative absorption caused by the formation of the C-layer prior to ground sunrise. On the basis of several electron density distributions and plausible collision frequency profiles, the non-deviative absorption of several assumed C-layers is computed. Also, the results of full-wave solutions are presented. The implications of the theory and experiment conclude this report. Author

N65-35591# Stockholm Univ. (Sweden). International Inst. of Meteorology.
A PHOTOCHEMICAL MODEL FOR THE SPACE-TIME VARIATIONS OF THE OXYGEN ALLOTROPES IN THE 20 TO 100 KM LAYER
James R. Blankenship [1965] 57 p refs
(AD-619303)

A time dependent model atmosphere is developed which will provide the height distribution of ozone as a function of location, time of year, time of day and meteorological conditions in the absence of transport and diffusion. The resulting distributions are then compared to the photochemical equilibrium distribution as obtained from the infinite-day approximations, i.e., those stationary solutions obtained by assuming that time goes to infinity with the radiation remaining constant. Author

N65-35598# Naval Postgraduate School, Monterey, Calif.
THE SEASONAL VARIATION OF PERMANENT CURRENTS WITHIN BAFFIN BAY
Robert L. Ceres (M.S. Thesis) 1965 56 p refs
(AD-618886)

The seasonal variation of permanent currents within Baffin Bay is investigated. A model based on physical reasoning is developed, whereby the speed of surface currents may be calculated during winter months, when observations are not available due to ice coverage. Verification is made where possible utilizing late fall, and early spring data. Limitations, applications, and variability of results are discussed. Two important applications are: first, to add to the oceanographic knowledge of the Baffin Bay area, and second, to provide an additional input to computer programs already in existence for forecasting the drift of sea ice within Baffin Bay. Author

N65-35626# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDIES IN GEOMAGNETISM AND AERONOMY STATE OF INVESTIGATIONS IN THE FIELD OF TERRESTRIAL CURRENTS
V. A. Troitskaya and O. M. Barsukov 15 Dec. 1964 14 p refs
Transl. into ENGLISH from Issled. po Geomagnetizmy i Aeronomii, (USSR), 1963 p 53–59
(FTD-TT-64-640/1; AD-610419)

The history of terrestrial currents registration is reviewed and the investigation of the morphology of geoelectric variations from 17 stations in the Soviet Union during the IGY is summarized. The mean annual value of electric field intensity at South Pole stations Mirnyy and Oasis constituted 750 to 800 mV/km which exceeded by about two orders of magnitude the corresponding values for mean latitude stations. The diurnal process of perturbations at these two stations has a clearly expressed maximum of about 7 hr of universal time with an amplitude of several hundred mV/km. Oscillations of terrestrial currents with periods of 5 to 20 minutes noticed simultaneously over a majority of mean latitude stations were clearly recorded at Arctic and Antarctic observatories. The most interesting result of analyzing the main phase of the magnetic storm was the detection of characteristic oscillations decreasing in period and originating in moments close to maximum depression of horizontal magnetic field components. It was observed that, in a majority of cases within several hours prior to the outbreak of storms, series of pearl type oscillations do originate. E.E.B.

N65-35652# Innsbruck Univ. (Austria).
DETERMINATION OF ROCK CONDUCTIVITY IN A MINE GALLERY. SOLUTION OF THE RESPECTIVE BOUNDARY PROBLEM. Interim Scientific Report No. 13
G. Tinhofer 1 Apr. 1965 30 p refs
(Contract AF 61(052)-490)
(AFCRL-65-430; AD-617922)

Conductivity determination of natural rock below ground requires the solution of the boundary problem for the potential of two electrodes on a hollow cylinder surface. An asymptotic representation is given for this potential. The current flow through the plane is calculated. Author

N65-35661# Air Force Cambridge Research Lab., Bedford, Mass. Upper Atmosphere Physics Lab.
DATA PREVIOUS TO THE INTERNATIONAL GEOPHYSICAL YEAR I: 5577 (OI) LINE AT SACRAMENTO PEAK, NEW MEXICO.
G. J. Hernandez May 1965 59 p refs *Its* Environmental Res. Papers No. 104
(AFCRL-65-319; AD-617248)

Zenith intensity measurements of the 5577 [OI] green line of the night airglow taken at Sacramento Peak, New Mexico, previous to the International Geophysical Year are presented in tabular form. A discussion on the present knowledge of the night airglow features, instrumentation, and calibration of the instruments is also included. Author

N65-35676# Columbia Univ., New York.
WEATHERING EFFECTS ON THE STRUCTURES OF MICA-TYPE CLAY MINERALS Scientific Report No. 2
Neclip Güven and Paul F. Kerr Bedford, Mass., AFCRL, Feb. 1965 37 p refs
(Contract AF 19(604)-8387)
(AFCRL-65-129; AD-617560)

Mica-type clay minerals are subjected to an intensive weathering process in the basin of the Willard Reservoir, north of Ogden, on the playa margin of Great Salt Lake. Weathering attacks the interlayer region of the layer lattice silicates most intensively where the bonds are weakest. A continuous scattering in the lower angle region of the (001)-reflection with some sharp superimposed maxima shows the heterogeneity along the c-axis of the mica-type layers; it also shows the genetic relation between the mica-type layers with different basal spacings. The pronounced continuous scattering accompanying the (02,11) diffraction band on the Guinier photographs and the absence of (hkl) reflections show that the layer silicates in the Willard clays possess an intensive disorder in their a-b planes. The values of the b-dimensions, high SiO_2/Al_2O_3 ratios and appreciable amounts of $MgO + FeO + Fe_2O_3$ indicate that mica-type layers are possibly derived from tetrasilicic members of dioctrahedral mica. Author

N65-35698# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONNECTION OF BRIEF PERIODIC OSCILLATIONS (KPK) OF THE TERRESTRIAL ELECTROMAGNETIC FIELD WITH AURORA POLARIS ILLUMINATION INTENSITY VARIATIONS
R. G. Skrynnikov 2 Jul. 1965 18 p refs Transl. into ENGLISH from Issled. Geofiz. Yavleniy Elektromagnitn. Kompleksa v Vysokikh Shirotakh, Kol'skiy Filial, Akad. Nauk SSSR, 1964 p 29–38
(FTD-TT-65-112/1+2+4; AD-617683)

The history of investigations of the relationship between illumination intensity variations of aurora polaris and the variations of the terrestrial electromagnetic field is reviewed. Preliminary results of comparing brief periodic oscillations of the terrestrial electromagnetic field with variations of aurora glow intensities are presented. It was concluded that the quiescent state of brief periodic oscillations of the electromagnetic field indicates the absence of radiance. A reverse statement is not true; brief periodic oscillations are observed in the absence of radiance. Trains and peaks with periods of 1 to 2 sec are observed indicating that oscillations of this type are not connected with the aurora emission. Oscillations of greater periods do appear to be closely connected with the auroras. E.E.B.

N65-35710# Rhode Island Univ., Kingston. Dept. of Electrical Engineering.
RESULTS OF SIMULTANEOUS ELF MEASUREMENTS AT BRANNENBURG (GERMANY) AND KINGSTON, R. I. Final Report, Part 1, 15 Jun. 1960–14 Jan. 1965
T. J. Keefe, C. Polk, and H. L. Koenig (Tech. Hochschule, Munich) 15 Jan. 1965 26 p refs *Its* Sci. Rept. No. 3
(Contract AF 19(604)-7252)
(URI-7252/3; AFCRL-65-200(I); AD-614012)

Based upon earlier work a series of measurements of the horizontal magnetic field in the extremely low frequency range was performed in Kingston, R. I., U.S.A., and Brannenburg, Germany between May, 1963 and June, 1964. Simultaneous readings on paper tape running at 25 mm/sec obtained on 30 different dates for a total of approximately 321 minutes indicate that some ELF bursts were received simultaneously and must have originated from a common source; most of the time, however, the records at the two stations were not similar in appearance. The rectified output of a narrow band filter about the frequency range of the first Schumann resonance was recorded continuously at both stations over periods of several months. Recordings at the two locations exhibit very similar diurnal variation if the data are referred to *local* time. Author

N65-35738# Massachusetts Inst. of Tech., Cambridge.
ON FACTORING THE CORRELATIONS OF DISCRETE MULTIVARIABLE STOCHASTIC PROCESSES Scientific Report No. 9
Ralph Ambrose Wiggins (Ph.D. Thesis) 28 Feb. 1965 195 p refs
(Contract AF 19(604)-7378; ARPA Order 180-61; Proj. Vela-Uniform)
(AFCRL-65-207; AD-614040)

The theory of discrete scalar time series analysis was extended to multivariable processes, with the extension facilitated by expanding the algebra of polynomial matrices. To simplify the analysis and notation of the factorization problem, a technique was developed for mapping processes with several independent variables into a form with several dependent variables and only one independent variable. The structure of discrete linear operators is discussed, and the z-transform, one-dimensional scalar wavelets, one-dimensional matrix-valued wavelets, and multi-dimensional wavelets are examined. Details are given on the factorization of an elementary autocorrelation matrix, the Smith–McMillan factorization technique, the Wiener-Masani approximate factorization by projections, and the recursive algorithm for least-squares filters. An expansion of the least-squares approximate factorization to the calculation of filters with specified noise suppressing and signal shaping properties is presented. Also included are computational examples illustrating some forms that such computations may take. M.G.J.

N65-35774# Michigan State Univ., East Lansing.
A STOCHASTIC MODEL FOR THE EVOLUTION OF CLOUD COVER—ESTIMATION OF PARAMETERS AND GOODNESS OF FIT BASED ON BOSTON DATA Final Report
Martin Fox and Herman Rubin Bedford, Mass., AFCRL, 7 May 1965 79 p refs
(Contract AF 19(628)-355)
(RM-132; MF-6; HR-15; AFCRL-65-243; AD-616394)

A stochastic model is proposed for the evolution of cloud cover. In this model each of the four observable states (clear, partially cloudy, cloudy, and overcast) is assumed to be the image under some function of two states of an eight state Markov chain. Estimates are given of transition probabilities in the observable four state process. Tables which allow assessment of the accuracy of the estimates and of the goodness of fit of the model are also provided. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-34873# Battelle-Northwest, Richland, Wash.
AN INSTRUMENT FOR MEASURING BOWING IN LONG TUBES
B. B. Brenden and J. C. Spanner Aug. 1965 36 p
(Contract AT(45-1)-1830)
(BNWL-59) CFSTI: $2.00

A device, capable of measuring bowing in long tubes that are bent excessively and are otherwise inaccessible for line-of-sight measurement, is described. The device, used to measure the degree of bowing of reactor process tubes, employs a linear variable differential transformer to measure the radius of curvature of the tube centerline. Measurements at regular intervals along the tube length provide data for calculating bowing distortion. Design parameters affecting the accuracy of computed bowing distortions and the bowing distortions themselves are computed from data using Fortran II computer programs. Data are discussed and examples of typical performance are given. Author

N65-34922# European Atomic Energy Community, Brussels (Belgium).
MULTIPLEX MEASURING SET-UP FOR REGISTERING SEVERAL MEASURING DATA VIA A SINGLE CABLE (E.G. ONE-WIRE COAXIAL CABLE) BY UTILIZING ONLY PASSIVE COMPONENTS (R, L, C) FOR MEASURAND CONVERSION ON THE INTAKE SIDE OF THE CABLE [MULTIPLEX-MESSEINRICHTUNG ZUR ERFASSUNG MEHRERER MESSDATEN UBER EIN EINZIGES KABEL (z.B. EINADRIGES KOAXKABEL) BEI VERWENDUNG NUR PASSIVER BAUELEMENTE (R, L, C) ZUR MESSWERT-WANDLUNG AUF DER EINGANGSSEITE DES KABELS]
W. Becker May 1965 23 p In GERMAN, ENGLISH summary
(EUR-2421.d) CFSTI: HC $1.00/MF $0.50

It is shown that the principle of a measurement set-up allows the conversion of several slowly changing measurands by a transducer system in such a way that they can be transferred as electrical oscillations of certain frequencies and this by means of a common high frequency cable from the place of measurement to the evaluation room. Because of the nuclear radiations in the place of measurement, there should only be installed passive elements, such as L, C and R. The proposed set-up is therefore mainly consisting in an amplifier with positive feedback on the evaluation side and furnished with switchable frequency passbands. The definite oscillation frequency of this system is always determined by the very resonant circuit in the place of measurement tuned to a frequency inside the chosen passband. The resonant frequency of each of the used resonant circuits in the place of measurement is influenced by one of the measurands to be measured. Author

N65-34950*# Jet Propulsion Labs., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY X-RAY DIFFRACTION PROGRAM Progress Report of Research and Development, Jul. 1964–Mar. 1965
R. C. Speed, J. A. Dunne, and D. B. Nash, ed. 1 Jun. 1965 191 p refs
(Contract NAS7-100)
(NASA-CR-67178; JPL-TM-33-218) CFSTI: HC $5.00/MF $1.25 CSCL 20F

Papers are presented which summarize scientific research and instrument development during the interval from July 1, 1964 to March 1, 1965 in the Lunar and Planetary X-Ray Diffraction Program at the Jet Propulsion Laboratory. For individual titles see N65-34951–N65-34971.

N65-34951* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH-VOLTAGE POWER-SUPPLY DESIGN
D. Spreng and A. C. Dunk *In its* Lunar and Planetary X-ray Diffraction Program 1 Jun. 1965 p 9–19 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The general requirements for the power supply for the X-ray diffractometer are given as follows: (1) output voltage of 25 000 V ±1%; (2) anode current to the X-ray tube of 1 mA ±0.1% under all operating conditions; (3) no high voltage arc under any combinations of environmental temperatures and pressures encountered during launch or space flight; (4) high-voltage shielding for radio frequency interference; (5) power conversion efficiency above 80%; (6) small size and lightweight power supply package; and (7) integrated circuitry where possible. The design described was not optimized for weight, size, or power dissipation; however, the prototype unit will demonstrate the feasibility of the approach to packaging a high-voltage power supply for a space mission. The characteristics of the prototype are included. E.E.B.

N65-34952* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARK 1 DIFFRACTOMETER ELECTRONICS
D. Spreng *In its* Lunar and Planetary X-ray Diffraction Program 1 Jun. 1965 p 21–31 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The electronic equipment consists of three subsystems: power supply, logic, and data processing. These are illustrated in a diffractometer–electronics block diagram. Three methods were considered for scanning and data handling for transmission. Advantages and disadvantages of each method are discussed. A block diagram is shown of the digital data converter. The purpose of this device is to accumulate counts for one second and, during the 1/4-sec period, to convert the total number of counts into a binary word which is then telemetered to Earth. The converter consists of a 13-bit ripple-through counter. X-ray photons are detected in a proportional counter tube where they are converted to a small current pulse. This pulse is applied to a two-stage integrated circuit amplifier where it is amplified to produce a voltage pulse sufficient to activate the pulse height discriminator. A block diagram of the motor-driven logic subsystem is also given. E.E.B.

N65-34957* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GUIDELINES FOR THE DEVELOPMENT OF A LUNAR SAMPLE PREPARATION SYSTEM
D. B. Nash *In its* Lunar and Planetary X-ray Diffraction Program 1 Jun. 1965 p 51–69 refs (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The problem of sample preparation for the X-ray diffractometer is discussed and the guidelines for proper selection

and handling of lunar rock samples for X-ray analysis are summarized. Also, minimum sample requirements, sampler-design constraints, and model lunar surfaces for testing sampler mechanisms are presented. Particle size, grain shape, preferred orientation, porosity, homogeneity, thickness, contamination, fractionation, and excessive temperature are considered. The design constraints considered are (1) A minimum of two lunar samples and one Earth standard are to be provided. (2) Pulverization must be simultaneous with sample acquisition. (3) Particles should not be screened for particle size separation. (4) Gravity should not be relied upon for the movement of the sample. (5) Power requirements, weight, and complexity of the system should be as low as possible. E.E.B.

N65-34964* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PRELIMINARY INVESTIGATION OF THE FEASIBILITY OF A RADIOISOTOPE X-RAY SOURCE

J. A. Dunne *In its* Lunar and Planetary X-ray Diffraction Program 1 Jun. 1965 p 143–145 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The advantages of a radioactive isotope X-ray source for lunar X-ray diffractometry and the disadvantages of this type of source are presented. On the basis of preliminary calculations, the feasibility of the radioisotope source suitable for use in this application does not appear promising. However, investigation of this method for the production of X-rays will continue in light of the advantages which the elimination of the X-ray tube would have on the spacecraft diffraction instrumentation. E.E.B.

N65-34965* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

TOTAL IRON ANALYSIS BY ANCILLARY NON-DISPERSIVE X-RAY FLUORESCENCE INSTRUMENTATION

J. A. Dunne *In its* Lunar and Planetary X-ray Diffraction Program 1 Jun. 1965 p 147–154 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The feasibility of total iron analysis by non-dispersive X-ray fluorescence detection in an X-ray diffractometer is discussed. The primary radiation employed in the present lunar diffractometer lies just on the short wavelength side of the FeK fluorescence absorption edge with the result that the efficiency of production of Fe fluorescence radiation in the diffraction sample is high. This same relationship also allows efficient discrimination against CuK_α scattered from the sample by the use of an Fe foil filter over the detector aperture. The experimental arrangement employed in the fluorescence analysis measurements is shown. Although the method has excellent sensitivity, it is subject to accuracy degradation due to matrix absorption variations. A given weight of Fe in a highly absorbing matrix will produce a significantly lower fluorescence intensity than the same weight percent Fe in a weakly absorbing matrix. This effect is shown in which the fluorescence intensity measured using hematite–quartz mixtures and hematite–CaO mixtures is plotted against weight percent Fe. Methods for the correction of absorption errors are considered. E.E.B.

N65-34979# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

A CONTROL AND READ-OUT SYSTEM FOR THE CHALK RIVER DOUBLE CRYSTAL γ-SPECTROMETER

W. D. Howell and W. R. J. Shorey Apr. 1965 108 p refs (AECL-2219) CFSTI: HC $4.00/MF $0.75

The Chalk River Double Crystal γ-Spectrometer designed for precision measurement of gamma ray energies requires, as part of its automatic positioning system, a control unit to program the direction and running time of three motors. Two of these motors control the rotation of the two diffracting crystals and the third controls the angular measuring device which tracks the movement of the crystals. The motors are operated in incremental steps which are measured by microswitches riding on the teeth of spur gears in the drive mechanism. On completion of a required spectrometer increment a counting operation is performed on the gamma beam for a preselected time. The read-out system then records the accumulated data on a Brown recorder, an IBM typewriter and, if desired, on a tape punch in either IBM (8 hole) or Datatron (7 hole) code. The spectrometer is programed to scan back and forth across a gamma line, reading the data as it proceeds. Author

N65-34991# General Dynamics/Convair, San Diego, Calif. Research and Advanced Technology Dept.

VARIABLE BANDPASS MONOCHROMATOR MODIFICATION

M. L. Streiff and C. C. Ferriso Aug. 1965 74 p refs (Contract Nonr-3902(00); Proj. Defender) (GD/C-DBE-65-016; AD-470879)

The straight exit slit jaws of a commercial monochromator were replaced by a slit mechanism to give independent choice of entrance and exit slit widths and to permit use of the instrument over a broad range of shapes and widths. The transmission or slit function is approximately trapezoidal for slit widths which are wide when compared to diffraction pattern width; half intensity width of the slit function is governed by this wider slit width, while the width of each trapezoidal sloping portion and output intensity at the transmission maximum is determined by the narrower slit width. Theoretical performance is calculated by two methods: one uses a small digital computer, the other requires only wavelength calibration and slit width data. Fortran programs are included for the slit function as well as index of refraction, prism calibration, and scan function. Scan function is obtained from a wavelength scan using a fixed wavelength monochromatic source. Scan and slit functions are found to be nearly equal when there is no wavelength variation of losses; scan function is usually easier to measure than slit function. M.W.R.

N65-35062*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MECHANISMS FOR SPACECRAFT OPTICAL INSTRUMENTATION

John P. Bauernschub Washington, NASA, Oct. 1965 15 p (NASA-TN-D-3008) CFSTI: HC $1.00/MF $0.50 CSCL 14E

Several mechanisms which were developed specifically for the airglow optical experiment on the Polar Orbiting Geophysical Observatory (POGO) spacecraft are readily applicable to other spacecraft instruments or applications. Described in detail are the design and operation of a 2-1/4 inch diameter aperture shutter, a system for rapidly indexing mirrors, and a solenoid initiated protective lid for shielding viewing ports during launch. Special problems such as lubrication of an optical device for continuous operation in space are discussed. Author

N65-35099# California Univ., Los Angeles. Dept. of Biophysics and Nuclear Medicine.

AN IMPROVED VISUAL NULL-POINT INDICATOR FOR THE BOUYOUCOS SOIL MOISTURE BRIDGE

R. A. Harvey Aug. 1965 11 p refs
(Contract AT(04-1)-GEN-12)
(UCLA-12-568)

The operation and modification of a Bouyoucos soil moisture bridge is presented. The bridge employs a calibrated potentiometer with an audio signal supplied to earphones for nulling the instrument. As the potentiometer is adjusted with a soil block in the circuit, and the bridge approaches balance, the volume of the 1000 cps signal diminishes. Ideally, the audible signal vanishes altogether as the null point is reached. The reading on the calibrated dial then represents the resistance of the soil block which is in hydraulic equilibrium with the soil. As resistance is inversely proportional to the amount of moisture present in the soil block, the reading obtained is a measure of the amount of moisture in the soil. Modifications consist of the addition of a resistor, the use of an edgewise microammeter, and placing the bridge into a specially built plyboard box. C.T.C.

N65-35174# Giannini Controls Corp., Duarte, Calif.
BRUSHLESS PRECISION POTENTIOMETER Interim Development Report, 5 Feb.–30 Jun. 1965
22 Jul. 1965 37 p refs
(Contract NObsr-91175)
(ER-8645-4; AD-618913)

Two satisfactory methods of encapsulation which will prevent deterioration of the photoconductive element have been proven. The temperature coefficient of resistance was found to be an inverse function of the absolute value of input resistance. Analysis of data indicates that the temperature coefficient may be kept within specification for all absolute values of resistance by varying the width of the resistive element. Modification of evaporation masks is necessary to enable manufacture of elements within linearity requirements. Utilizing materials and processes established during the program, a prototype potentiometer was fabricated and preliminary evaluation provides confidence that with design refinement, the potentiometer is capable of meeting the design specification. Author

N65-35191# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SIMULATION OF A SATELLITE GYROSCOPIC ATTITUDE CONTROL SYSTEM WITH ORBITAL PITCH RATE
Paul C. Pleva, Jr. (M.S. Thesis) May 1965 118 p refs
(GGC(EE)65-11; AD-619035)

A satellite gyroscopic attitude control system using four single-degree-of-freedom control gyros is analyzed by signal flow graphs, and simulated on an IBM 7094 computer using a digital analog simulation subroutine. A signal flow graph is first developed for one gyro, and then extended to the four gyro configuration. A transfer function is derived for each axis from the signal flow graph, and coefficients are chosen to optimize performance about the X and Y axes which have equal moments of inertia. The Z axis has a moment of inertia one-fortieth of the other two, and the resulting higher natural frequency is compensated by a Z axis angular accelerometer. Digital simulation demonstrated that the system is capable of correcting step and rate errors about each axis. Orbital pitch rate is introduced causing the net gyro spin momentum vector to precess. The simulated flight computer torqued the gyros to correct for the precession. This maintained the spin momentum vector fixed in inertial space while the vehicle maintained its pitch rate. Author

N65-35198# Santa Barbara Research Center, Goleta, Calif.
PRODUCTION ENGINEERING MEASURE PbSe INFRARED DETECTOR—TYPE IR-200 Quarterly Progress Report, 1 Jul. 1964–31 May 1965
G. H. Cook 10 Aug. 1965 64 p
(Contract DA-36-039-AMC-01466(K))
(QPR-7; AD-619082)

Preproduction qualification tests were conducted on PbSe infrared detectors, with only minor test problems encountered. Inspection and test procedures are summarized for the PbSe cell, the inner flask assembly, the completed inner and outer flasks, and the cell package assembly. Engineering comments on variances in test results are reported, and a graph plotting detectivity versus dynamic resistance is included. M.G.J.

N65-35209*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
REDUCTION OF ERRORS IN VIBRATORY GYROSCOPES BY DOUBLE MODULATION
Richard W. Bush and George C. Newton, Jr. [1964] 24 p refs
Presented at the 2d Symp. on Unconventional Inertial Sensors and the 1964 Joint Autom. Conf., Stanford, Calif., Jun. 1964
Submitted for Publication
(Grant NsG-149-61)
(NASA-CR-55540) CFSTI; HC $1.00/MF $0.50 CSCL 17G

Vibratory drive, vibratory output instruments for sensing angular rates, such as tuning forks, potentially offer certain advantages over conventional gyroscopes. The theoretical performance of these devices has not been realized experimentally because of zero-rate errors attributed to mass unbalance, driving force unbalance and other imperfections. By separating the driving and sensing frequencies through a process called double modulation, obtained through an additional rotation or vibration of the basic sensing element, zero rate errors may be diminished. Theoretical and experimental evidence in support of the double modulation concept is presented. A tuning fork type of instrument has been used in the initial experiments and a substantial improvement over the performance of the same instrument without double modulation has been realized. Author

N65-35222*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPECTRAL MEASUREMENTS ON HIGH INTENSITY LIGHT SOURCES
John C. Flemming and Charles H. Duncan [1964] 21 p refs
Submitted for Publication
(NASA-TM-X-51838) CSCL 14A

Measurements of the spectral distributions of a xenon, mercury–xenon, and carbon arc have been accomplished. The carbon arc and xenon arc have spectral distributions most similar to air mass zero solar irradiance. The absorptivities of gold, silver, and aluminum have been calculated using the measured spectral distributions. The per cent variations from the solar absorptivities of these materials vary from −3% to +26% for the xenon arc; −26% to +11% for the carbon arc; and, −8% to +77% for the mercury–xenon arc. Author

N65-35237*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RECENT DEVELOPMENTS IN PRESSURE ALTIMETRY
William Gracey [1964] 12 p refs Presented at the AIAA 1st Ann. Meeting and Tech. Display, Washington, D. C., 29 Jun.–2 Jul. 1965
(NASA-TM-X-51619) CFSTI: HC $1.00/MF $0.50 CSCL 01D

Some of the more significant accomplishments of recent years relating to the improvement of instruments, the measurement and compensation of the errors of static-pressure systems, and the collection of information on the flight technical error are reviewed. Previous studies of the relation between altimetry errors and vertical separation standards are discussed and the problem of assessing vertical separation standards is examined from an approach different from that used in those studies. On the basis of the present review, the need for further work is indicated for standardizing the calibrations of static-pressure systems, for collecting additional information on the flight technical error, for developing an altitude-deviation monitoring and warning device, and for improving the maintenance practices relating to the testing and installation of the instruments. Author

N65-35281*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A TWO-PLANE SIX-COMPONENT BALANCE
John Dimeff, Keith H. Mc Farland, I. N. Chabra, and E. Conley [1964] 9 p Presented at the 21st Semi-Ann. Meeting of the Supersonic Tunnel Assoc., Princeton, N. J.
(NASA-TM-X-51652) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A 2 1/2-inch-diameter two-plane internal strain gauge balance for use in wind tunnels is described. This balance has the following advantages: (1) maximum balance stiffness; (2) low cost of machining and fabrication; (3) passage of leads through a hollow inner support of the balance; (4) small temperature effects on axial force; (5) low interactions; (6) flexible loadings; and (7) assembly less critical than for floating balances. Disadvantages of the balance are: (1) critical gage placement; and (2) limited minimum size due to support strength and space requirements. The cylindrical outer sleeve, balance, and stress distribution are shown. E.E.B.

N65-35342# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
ACOUSTIC AMPLIFICATION IN III-V COMPOUNDS Quarterly Report, 1 Feb.–1 May 1964
F. S. Hickernell [1964] 56 p refs
(Contract AF 33(615)-1109)
(QR-2; AD-465235)

Acoustic velocities in InSb, GaSb, AlSb, and InAs are given for shear and longitudinal modes. Also, the elastic moduli are tabulated for these same compounds. The values of velocity and elastic moduli were in reasonable agreement with previously published values. These measurements establish the basic low frequency velocity value which can be used in determining the electromechanical coupling coefficients for these materials. Methods for the evaluation of the electromechanical coupling coefficients in low resistivity samples are discussed. E.E.B.

N65-35352*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INVESTIGATION AND DEVELOPMENT OF AN RF LIQUID LEVEL SENSING TECHNIQUE Summary of Laboratory Investigation, Jul. 1964–15 Feb. 1965
J. D. Lockhart 15 Feb. 1965 71 p refs
(Contract NAS8-11476)
(NASA-CR-67313; LMSC-A734537) CFSTI: HC $3.00/MF $0.75 CSCL 14B

The radio frequency, resonant-cavity sensing technique is found to give a high degree of accuracy with good resolution for the determination of liquid level. Test results indicate that the technique may be adaptable for use under zero "g" conditions. Installation of the system is simple, weight and power requirements are low, and reliability is high. Tank measurements were made to determine modes, phases and impedance; and to determine the effect of internal tank configurations. These configurations included a simulated slosh baffle, a simulated metallic suction line, and internal cryogenic insulation. To simulate zero "g", an internal tank void was provided by a hollow nonmetallic tube. Influence of surface effects on system accuracy and mode jumping was investigated. Two types of RF instrumentation were used: one is a sweep generator that requires manual tracking of resonant frequency, the other employs a self-excited oscillator technique in which the tank is the frequency-determining element. M.W.R.

N65-35359*# Sperry Gyroscope Co., Great Neck, N. Y. Inertial Div.
DEVELOPMENT AND FABRICATION OF ADVANCED DESIGN RATE GYRO Monthly Progress Report No. 3, 1–30 Sep. 1963
J. Mott 15 Sep. 1963 5 p
(Contract NAS8-5464)
(NASA-CR-67343) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Magnesium transducer diaphragms of 0.0002 inch thickness improved the sensitivity of an advanced design rate gyro which had used thicker aluminum diaphragms. A bias output of five degrees per second resulted when the thinner diaphragms were used. When a cup was added to the model to stiffen the coupling from the shaft to the outer edge of the housing, bias was decreased to one-half degree per second and it was possible to observe the model's performance at rates below one degree per second. Additional study is required to further reduce the bias. On-board networks for transducer excitation and output null adjustment have been designed. Most of the detail drawings of the experimental model have been completed, and the tools required for its assembly are being manufactured. M.W.R.

N65-35440# California Univ., Berkeley. Lawrence Radiation Lab.
ON THE COMBINATION OF THE PHASE CONTRAST PROCESS WITH FLUORESCENCE MICROSCOPY
F. Gabler and F. Herzog Jun. 1965 10 p refs Transl. into ENGLISH from Appl. Opt., v. 4, no. 4, Apr. 1965 p 469–472
(UCRL-TRANS-1228)

After discussion of several technical problems regarding instrumentation of fluorescence microscopy and of the ways how to solve them, a device is described which makes it possible to examine fluorescent specimens both in positive and negative phase contrast (so-called simultaneous contrast fluorescence). Furthermore, light filtration and the relating questions are briefly mentioned. Finally, the resulting effects and the manifold fields of application of this new device are demonstrated with the aid of two examples and its advantages are discussed. Author

N65-35496* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO REMOTE SITE DISPLAY SYSTEM
G. N. Georgeadis *In its* Proc. of the Apollo Unified S-Band Tech. Conf. 1965 p 205–222 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

A description of the display system which will be used to monitor and control the spacecrafts during the many phases of Project Apollo is presented. The operation and output capability of the system is discussed together with equipment located

in the Apollo flight operations room such as the fast access file and display system, silenced teletypewriters, and the group display is also discussed briefly. Author

N65-35507# Royal Aircraft Establishment, Farnborough (England).
NEW METHODS FOR MEASURING THE COURSE OF ACCELERATION OF VEHICLES [UBER NEUE METHODEN ZUR MESSUNG VON BESCHLEUNIGUNGS-VORGANGEN AN FAHRZEUGEN]
H. Steinbrenner and H. J. Florus Jul. 1965 23 p refs Transl. into ENGLISH from Automobiltech. Z. (Berlin), v. 67, no. 1, 1965 p 1–7
(RAE-LIB-TRANS-1120) CFSTI: HC $1.00/MF $0.50

Two essentially different measuring apparatus for investigating the course of acceleration of vehicles during the acceleration process and for measuring the braking distance are described. One method concerns the vehicle and employs a fifth wheel to transmit impulses from the road. The impulses are further processed electronically and the apparatus furnishes an acceleration–time diagram or the digital braking distance as the case may be. The second measuring technique is concerned with distances and uses radar. After appropriate processing the apparatus also supplies an acceleration–time diagram or the digital braking distance, and in addition a distance–time diagram. Author

N65-35573# Aberdeen Proving Ground, Md. Ballistic Research Labs.
A MULTI-CHANNEL PIEZOELECTRIC RECORDING SYSTEM
Rodney R. Abrahams May 1965 21 p
(BRL-MR-1650; AD-470780)

This report described a multichannel piezo, oscillographic recording system designed to be used for the measurement of overpressure-time phenomena. Author

N65-35593# Texas Instruments, Inc., Dallas. Apparatus Div.
MICROELECTRONIC FREQUENCY AND TIME STANDARD Quarterly Progress Report No. 4, 1 Apr.–1 Jul. 1965
Arlie D. Teel 15 Jul. 1965 13 p
(Contract NObsr-91352)
(U4-807240-4; AD-617563)

The frequency standard oscillator continued to be the major problem during this reporting period. The problems described in the last report with the CR-71/u crystals were solved the latter part of April and tests were begun on the prototype oscillator. All specifications were met except frequency stability over the environmental temperature range of 5 parts per 10^{10}. This problem has been determined to be partly caused by incorrect thermistor location on the inner oven. This was corrected, but a change of 2 parts per 10^{9} still existed. At the time of this report, it appears to be the result of voltage variations caused by a zener diode in the power supply which affects the frequency control varicap. A change to a more stable reference diode appears to have corrected this problem. The remaining portion of the equipment was delayed again due to receipt of the SCN's (semiconductor networks). These were received 27 May 1965. Due to these problems, the delivery of the system will probably be delayed to 1 September 1965. Author

N65-35607# Basic Devices, Inc., Wellesley, Mass.
DEVELOPMENT OF AN AIRBORNE JET STREAM DETECTOR Final Report
Robert S. Djorup Feb. 1964 36 p refs
(Contract AF 19(628)-1677)
(AFCRL-64-194; AD-615466)

The basic concept employed was the determination of the differential degree of airstream cooling of two wing-tip mounted heated resistance probes connected in a modified Wheatstone bridge circuit configuration. The horizontal direction to the axis of the nearest jet stream core, counter to the direction of the aircraft, is indicated by the sense of that wing-tip probe whose lower resistance is brought about by an increase in relative wind gradient. The system was packaged for aircraft installation and consists of three elements: the wing-tip mounted probe pair, and the cockpit housed control and display unit. The report describes aspects of design, development, and laboratory tests. Author

N65-35616# New York Univ., N. Y. Engineering Research Div.
RESEARCH ON KINETICS OF DEFORMATION AND FRACTURE Final Report, Apr. 1959–Jun. 1964
H. Ezrol and H. Margolin Wright-Patterson AFB, Ohio, ARL, Jan. 1965 43 p refs
(Contract AF 33(616)-6430)
(ARL-65-21; AD-615445)

A high speed electronic photographic device, an image converter, was constructed to record the kinetics of fracture in metal samples. The image converter is capable of photographing at a framing rate as rapid as 2 million frames per second with as short an exposure time as 0.1 microseconds. Also assembled and constructed were an impact tensile apparatus, a high intensity light source, and a complex of electronic synchronizing mechanisms. The image converter and its accompanying equipment have been successfully synchronized. Photographs of cracks passing through polycrystalline zinc samples were obtained. Author

N65-35628# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ULTRASONIC FLAW DETECTOR
Verner Shteglikh 5 May 1965 6 p Transl. into ENGLISH from Patent No. 156367 (Appl. No. 770172/26-10, 23 Mar. 1962) Soviet Patent No. 156367 (Appl. No. 770172/26-10, 23 Mar. 1962) 3 p
(FTD-TT-64-1382/1+2; AD-615529)

An ultrasonic flaw detector (defectoscope) with a gate pulse for measuring a reflected signal from a definite depth was described. The device eliminates the absorption on the intensity of the reflected signals which were subjected to recording with integrating cascades. R.W.H.

N65-35677# Bendix Corp., Southfield, Mich. Research Labs.
AUTOMATED ANALYTICAL STEREOPLOTTER Second Technical Documentary Report, 1 Nov. 1963–30 Jun. 1964
Walter E. Chapelle Griffiss AFB, N. Y., RADC, Jun. 1965 54 p *Its* Rept.-2693
(Contract AF 30(602)-2942)
(RADC-TDR-64-405; AD-617762)

This report describes the development of an automated version of an AS-11A analytical stereoplotter. The system utilizes electronic image correlation in conjunction with the AS-11A control computer to automatically produce contour and profile charts. The equipment accommodates frame or panoramic photography, either vertical or convergent. The maximum rates of contouring or profiling are 10 millimeters

per second. Maximum terrain slope accommodated is 45 degrees. Capability is provided for automatic orientation of stereo-models and for visual monitoring during automatic operation. Author

N65-35702# Trans-Sonics, Inc., Burlington, Mass.
GRAPHITE STRAIN TRANSDUCER Final Report
Thomas A. Cederlund Griffiss AFB, N. Y., RADC, Apr. 1965 44 p refs
(Contract AF 30(602)-3276)
(RADC-TR-65-38; AD-616100)

This study was conducted to determine the applicability of using a graphite monoparticulate layer transducer as a means of detecting sound vibrations in diaphragms. Techniques were developed for the formation and deposition of monoparticulate graphite layers and their transfer to thin film substrates. Evaluation of deposited graphite layers as strain gauges showed gauge factors of 800 for strains of 500 microinches per inch. For strains of less than 50 microinches per inch, gauge factors decrease rapidly. Transduced audio signals, when detectable above the background noise of the sensor, are distorted and for the most part unintelligible. It is concluded that, because of sensor generated noise and the small changes in transducer resistance developed by low strains, the graphite monoparticulate sensor is not an optimum method to transduce audio vibrations in diaphragms. It appears, however, that the graphite monolayer transducer might have important application when sufficient strain is produced and where high gauge output is beneficial. Author

N65-35728# National Water Lift Co., Grand Rapids, Mich.
INSTRUMENTATION AND CONTROL OPERATIONS. MULTIFUNCTION SENSOR TECHNIQUE Final Report
Roland Pittman Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Mar. 1965 64 p
(Contract AF 33(615)-1200)
(AFFDL-TR-65-4; AD-617612)

An investigation into the feasibility of a technique for sensing, simultaneously in two axes, angular velocity and linear acceleration in a transducer with one moving part is presented. Techniques for instrumenting inertial interactions in a rotating frame were employed, utilizing piezoelectric electrostrictive devices for instrumentation, and fluid bodies for the inertial reaction member and proof mass. The technique was reduced to practice, resulting in a subminiature, fully integrated, compact, functional prototype wherein both types of outputs were provided in each of two orthogonal sensing axes. An integrated prototype was evaluated for all major performance parameters and operational characteristics. The results have revealed a transducer technique capable of angular velocity sensing thresholds of 1°/hr, and linear acceleration sensing thresholds of 10^{-5} G, with dynamic ranges in each of the two quantities in excess of one million to one. Also demonstrated, within the study, was the potential for high reliability redundant sensing techniques and further size and power consumption reduction while maintaining the extreme sensing thresholds. Author

N65-35773# North American Aviation, Inc., Columbus, Ohio.
IMAGE QUALITY ENHANCEMENT Technical Report, Dec. 1962–Feb. 1964
Robert W. Brainard and George N. Ornstein Wright-Patterson AFB, Ohio, AMRL, Apr. 1965 64 p refs
(Contract AF 33(616)-7996)
(AMRL-TR-65-28; AD-616895)

A technique for enhancing the quality of imagery was investigated. The technique consists of obtaining a video signal from a transparency and adding to this signal its first and/or second derivative(s). The efficacy of the technique was evaluated by comparing imagery produced by the video signal and its derivative(s) with imagery produced by the video signal alone. The imagery investigated consisted of standard test patterns and aerial photographs. The processed test patterns were quantitatively analyzed to determine the resolution, contrast, and acuteness of the imagery. The results indicate: (1) differentiation enhances image quality, as indicated by the resolution, contrast, and acuteness metrics; (2) greatest enhancement is produced by operations which include second-order differentiation; and (3) the least enhancement is produced by first-order differentiation. The aerial photographic imagery shows the same enhancing effects as those obtained with the test patterns. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-34788 Joint Publications Research Service, Washington, D. C.
DEVELOPMENT OF METROTECHNOLOGY IN CZECHOSLOVAKIA AND INTERNATIONAL COOPERATION IN METROTECHNOLOGY
F. Dostal *In its* Spectry. and Metrotechnol. in Czechoslovakia 16 Sep. 1965 p 19–27 (See N65-34786 23-34) CFSTI: $2.00

Increasing demands on the accuracy and efficiency of measuring devices led to the development of sensors for measuring dimensions and forms of the antifriction elements on the basis of both the electrocontact, and the induction principle. Described are electrocontact sensors that measure simultaneously the deformations of dimensions and the deviations of form in the range of 1 mm at a measuring force of 200 p; induction sensors suitable for automatic sorting devices; photoelectric automatic devices for controlling and sorting of bearing balls into accepts and rejects; and automatic sorting devices with continuous circular motion of the given parts during inspection and sorting processes that are connected with a memory disc. G.G.

N65-34800 National Lead Co. of Ohio, Cincinnati.
MODIFICATION OF AN ATTACK-POLISH PROCEDURE
M. H. Cornett and E. L. Schaich *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 155–157 (See N65-34789 23-17) CFSTI: $2.25

This paper describes the modification of an attack-polish procedure which reduced sample preparation time and provides a scratch-free surface on uranium metal. Author

N65-34801 Oak Ridge National Lab., Tenn.
ELECTRON METALLOGRAPHY OF PYROLYTIC CARBON COATINGS ON FUEL PARTICLES
C. K. H. Du Bose and J. O. Stiegler *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 159–171 refs Sponsored by AEC (See N65-34789 23-17) CFSTI: $2.25

A replica electron microscope study of as-polished and cathodically etched surfaces of pyrolytic carbon coatings on

fuel particles has been made in an attempt to characterize coatings that showed as much as 30% difference in bulk density. High and low density coatings could be characterized by their polished surface textures; however, these features were not indicative of the true structure as seen by direct electron transmission. Microvoids detected by the transmission study of cleavage flakes exist on too fine a scale to be observed either optically or by electron microscope examination of replicas of the polished surfaces. Other features such as the effect of cathodic and chemical etching, coating delamination, and duplex coating interfaces have also been examined. Author

N65-34802 General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

IN-CELL VACUUM IMPREGNATION OF METALLOGRAPHY SPECIMENS

F. L. Cochran and H. E. Shoemaker *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 173–183 ref (See N65-34789 23-17) CFSTI: $2.25

The problem of preparing porous, damaged, or badly cracked irradiated specimens for metallographic analysis was solved by vacuum impregnation of the specimens prior to preparation. It was found that the most desirable impregnating material was a mixture of Epon 815, Epon 812, and allyl glycidyl ether, using Dmp-10 as the hardening catalyst. The extremely low viscosity and long curing time of the epoxy compound resulted in complete impregnation at vacuum levels of from 1 to 30 μ. The impregnation apparatus was designed to accommodate a modified vacuum desiccator, which permitted impregnation and simultaneous mounting of from one to ten specimens during a single impregnation cycle. Direct radiation fields of from 5000 to 10000 r/hr did not embrittle the epoxy compound. Author

N65-34803 Argonne National Lab., Ill.

VIBRATORY GRINDING AND POLISHING OF METALLOGRAPHIC SPECIMENS

S. Matras *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 185–219 refs Sponsored by AEC (See N65-34789 23-17) CFSTI: $2.25

The range of metallographic specimen preparation by vibratory polishing has been extended to include the grinding operation. A controlled method has been developed that reduces the metallographic grinding operation to essentially one step. This was achieved by: (1) controlling the horizontal and vertical components of vibration by changing the springs and the weight of the base of the apparatus to conform to the specific requirements of grinding, (2) providing a special fixture that guides the specimen in a controlled and predetermined manner. The grinding fixture consists of a lucite bowl that holds an 8 in. diameter silicon carbide paper disc and a rotating turret in which the specimens are spaced and loaded with appropriate weights. The grinding produces specimens with surfaces which possess a minimum of disturbed metal with virtually no embedded abrasive. Author

N65-34853# Joint Publications Research Service, Washington, D. C.

CONFERENCES ON WELDING AND RELATED METALLURGICAL PROBLEMS

17 Sep. 1965 46 p Transl. into ENGLISH from Russian Publications

(JPRS-32062; TT-65-32555) CFSTI: $2.00

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N65-34866# Naval Civil Engineering Lab., Port Hueneme, Calif.

DEEP-OCEAN BIODETERIORATION OF MATERIALS. PART II: SIX MONTHS AT 2,340 FEET Technical Report, Dec. 1964–Apr. 1965

James S. Muraoka Aug. 1965 45 p refs

(R-393; AD-619014) CFSTI: $3.00

This is Part II of a series of reports on the biological deterioration of materials in the deep ocean. It covers the data obtained after exposing 2385 specimens of 603 different materials for 6 months (197 days) on the Pacific Ocean floor at a depth of 2340 feet. The materials were attached to a submersible test unit (STU). The STU was retrieved in December 1964 and returned to the Laboratory for test and analysis. There were marine fouling organisms attached to the plastic ropes, aluminum buoys, polyethylene-jacketed wire rope, nickel-plated shackles, and on some metal test specimens. Most of the plastic and all of the rope materials were covered with bacterial slime growth. Wood panels, plastics, and Manila rope were attacked by marine borers. Cotton and Manila rope specimens and jute-fiber burlap wrappings were severely deteriorated by bacterial action. Metal, glass, natural and butyl rubber, and some plastics with a smooth and extra hard surface were not affected. The biological effects on materials recovered from Test Site II are briefly compared with materials recovered from Test Site I. Author

N65-34904*# Auto-Control Labs., Inc., Los Angeles, Calif.

HIGH TEMPERATURE THERMOCOUPLE RESEARCH AND DEVELOPMENT PROGRAM. APPENDIX 4: NEW TECHNOLOGY Summary Report

R. R. Smith, Jr. 18 Jun. 1965 15 p

(Contract NAS8-5438)

(NASA-CR-67195; T-1097, Append. 4) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Solutions to a number of problems in developing high temperature thermocouples are presented. Solutions are described for a method of nickel brazing tungsten to tungsten and to tungsten–rhenium alloys, a technique for surface grinding

thermochemically formed thin walled tungsten tubing, a technique for fabricating mandrels for forming deposited tungsten parts, a method of mounting a tungsten part in a stainless steel body, techniques for eliminating electrical insulation in the hot zone of a coaxial thermocouple, a method of calibrating high temperature thermocouples in an arc-heated black body furnace, the protection of tungsten with deposited silicon, and the development of an EMF vs temperature curve for tungsten vs tungsten–26% rhenium from −320° to +5400° F. R.N.A.

N65-34958* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

DRILLING TEST PROGRAM

G. M. Hotz *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 71–78 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

A rock-drill development program was conducted concurrently with an investigation into means of sample acquisition, transport, and transfer for a sampling system for a lunar X-ray diffractometer to be used on unmanned landers. Both rotary and rotary-impact drilling were investigated. Rotary drilling was found to be an adequate means of fragmenting hard rock but a marginal processing method under the limitations imposed. Rotary-impact drilling proved to be much more dependable and efficient means of fragmenting and reproducibly processing hard rock. A mechanical rotary-impact breadboard drill of low power requirements and high efficiency was developed. Constraints, design goals, test procedures, and test results are discussed. It was concluded that a drill designed for the program should have the following characteristics: (1) 40 W power rating; (2) penetration rate of 0.6 inch/min; (3) normal force of 40 lb; (4) impact rate of 200 impacts/min; (5) impact energy per blow of 1 to 1 1/2 ft-lb; (6) bit rotational speed of 20 rpm; (7) bit diameter of 1/2 inch; and (8) tungsten carbide cutter material. E.E.B.

N65-34959* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ACQUISITION AND TRANSPORT MECHANISM

F. Teeple *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 79–86 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

A test program was conducted to evaluate several devices as acquisition and transport components of the X-ray diffractometer sampler breadboard. The devices were tested for acquisition efficiency, transport, contamination between samples, and fractionation of the sample by the acquisition and transport operations. Two of the devices tested, the hollow bit with an internal valve and the sleeved screw were found to best meet the functional requirements and exhibited satisfactory mechanical performance. Both were recommended for further study and possible use. The simple screw, hollow bits without valves, and conveyor belts did not meet sampler functional requirements and were not recommended. The simple screw allows excessive contamination and acquisition was marginal. The hollow bits without valves permit leakage of the noncohesive test models during retraction. Conveyor belts require control of maximum particle size to the extent of making acquisition submarginal when used with hollow bits. E.E.B.

N65-34960* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

AVIBRATORY SAMPLE EXTRACTOR

A. C. Dunk and U. A. Pineda *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 87–102 refs (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The design and development of the extractor subsystem for the X-ray diffractometer sampling system are discussed. Two important constraints were considered. The sampling system should be completely automatic and the system must operate in the lunar environment. The vibratory extractor appears to be a very promising solution to the sample production, acquisition, and transport phases of the sampling problem. However, considerable testing of an engineering prototype in an ultrahigh vacuum at reduced gravity must be done before the true potential of this method can be assessed. The engineering prototype would be required to meet weight, power, and material constraints. E.E.B.

N65-34961* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SAMPLE TRANSPORT AND PRESENTATION SYSTEM DESIGN

A. C. Dunk and U. A. Pineda *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 103–114 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

A development program is discussed for the continuous flow of material from the extraction point to the X-ray diffractometer. Rock drilling, sample preparation, extraction, delivery, transfer, presentation, analysis, and discharge are considered. The design of the continuous sampling mechanism is based on the principle of the vibrating tray for particle conveyance. The tray is designed to receive and convey all the material delivered from the extractor and will serve as the sample holder for the X-ray diffractometer. Also, a discrete sampling system is considered. In this approach the earth-standard sample will be placed in the diffractometer prior to launch and will remain there until after calibration at the lunar surface. A separate sampling system will prepare lunar samples in sample cups and subsequently position these cups as required in the sample cup holder on the goniometer of the diffractometer. Schematics of these two systems are shown. E.E.B.

N65-34962* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PERFORMANCE OF MARK 1 SAMPLER MECHANISMS

D. B. Nash *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 115–126 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

Samples prepared by various mechanisms under evaluation were examined to determine the suitability of these sampling devices for preparation of good X-ray samples. The quality of the sample was judged by comparing the X-ray diffraction patterns with diffraction patterns obtained from optimum hand-prepared samples of the same material. Further examinations to determine why some samples were of better quality than others included particle-size analyses, heating experiments, and fractionation tests. Parametric testing determined the drill bit, drill motions, and drilling rates which produce the best quality and most reproducible X-ray samples from hard rock. Over 200 test drillings were conducted on basalt and an optimum set of drilling parameters was chosen. It was found that poor-quality X-ray patterns result when the drill produces an excessive number of particles of less than 20 microns in size. Even in properly pulverized samples, the X-ray results on drill-prepared samples would not be significantly improved by exclusion of particles greater than 20 microns in size. E.E.B.

N65-34983# Atomics International, Canoga Park, Calif.

THE DEVELOPMENT AND QUALIFICATION OF THERMAL CONTROL COATINGS FOR SNAP SYSTEMS

J. R. Crosby 30 Sep. 1965 70 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9908) CFSTI: $1.75

Components of the (SNAP 2) Mercury-Rankine and SNAP 10A systems require various radiation control coatings which exhibit particular thermal emittance and solar reflectance properties. A specialty coating system, designated A193, has been developed for the SNAP 2 radiator-condenser and the SNAP 10A thermoelectric module and pump radiator fins. This coating exhibits a thermal emittance of 0.91 (400 to 700° F) and a solar absorptance of 0.30. Stability of this coating system in a nuclear and simulated space environment has been demonstrated. Other coating systems which have been developed and qualified are: (1) gold foil and gold on molybdenum foil for use as radiative insulation, (2) high-thermal-emittance coatings for use on heat-sensitive components, and (3) a mosaic coating pattern for use on the SNAP 10A ejectable heat shield. Data generated during the development of these coating systems along with the associated equipment descriptions are included herein. Author

N65-34986# Case Inst. of Tech., Cleveland, Ohio.
AN INVESTIGATION ON THERMAL AND MECHANICAL STABILITY OF MOLD MATERIALS FOR STEEL CASTINGS Interim Report, Jun. 28, 1963–Jun. 27, 1964
[1964] 47 p refs
(Contract DA-33-019-AMC-270(Z))
(AMRA-CR-64-03/1; AD-611799)

Test apparatus and technique were developed to measure the tensile strength of molding materials at elevated temperatures. The measurements of tensile strength obtained from this equipment permits a qualitative evaluation of the mechanical stability of the mold as molten steel enters and solidifies in the mold. Aggregates of mullite, molochite, silica sand, fused silica, calcined kyanite and calcined alumina were bonded with western bentonite and sodium silicate. Close dimensional control of the castings was obtained with fused silica, calcined alumina and silica sand bonded with sodium silicate and green, western bentonite bonded mullite. Better casting surfaces were obtained with the fused silica aggregate. A modified sodium silicate binder utilizing silicon metal fines to promote setting was investigated. The bond developed was stronger in tension and compression at both room and high temperatures than that produced by western bentonite or by gassing identical sodium silicate bonded aggregates. This sodium silicate–silicon fines binder combined with either fused silica or silica sand refractories provided a mold for casting steel to close dimensions with a good cast surface. Author

N65-34990# Mechanical Technology, Inc., Latham, N. Y.
RESEARCH ON GAS LUBRICATION AT HIGH TEMPERATURE AND LOW FLOW RATES Quarterly Progress Report No. 5, Jun. 15–Sep. 15, 1964
M. Eusepi and P. Lewis 15 Sep. 1964 70 p refs
(Contract AF 33(657)-10694)
(MTI-64TR53; AD-461003)

Progress is reported on the development of nitrogen gas lubricated journal and thrust bearings for stable operation over a temperature range of 80° to 1900° F and a speed range of 0 to 60000 rpm. Experimental work on the 360 degree hybrid bearing is summarized, including the inherent and orifice compensation cases. Also included is a summary of experimental work in progress on the flex pad bearing. The inherently compensated bearing stability can be predicted from a dimensionless map. The orifice compensated 360 degree hybrid bearing has a theoretical advantage over the inherently compensated bearing from the standpoint of stiffness. However, this is not realized unless the compensation number is much less than one. The orifice compensated bearing will also have higher flow, is susceptible to air hammer, and does not achieve the levels predicted for fractional frequency whirl. The air hammer frequency is usually the frequency of the lowest rigid body critical. The preferred design for high speed operation with a 360 degree hybrid bearing has inherent compensation with a compensation number in the order of two, clearance selected in accordance with required theoretical stiffness, and two orifice rows. R.N.A.

N65-35022# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
HOT EXTRUSION OF FINE PLUTONIUM WIRE
B. J. Beer and R. B. Fischer 27 Sep. 1965 9 p
(Contract AT(29-1)-1106)
(RFP-623) CFSTI: $1.00

Unalloyed plutonium wire with a diameter of 0.017 in. was extruded from a 0.170 in. diameter plutonium billet heated to about 230° C. Author

N65-35034# Atomics International, Canoga Park, Calif.
SECOND-CYCLE AIROX REPROCESSING AND PELLET REFABRICATING OF HIGHLY IRRADIATED URANIUM DIOXIDE
J. E. Bodine, J. Guon, and R. J. Sullivan 31 Aug. 1965 43 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11375) CFSTI: $2.00

Uranium dioxide (UO_2) irradiated to burnups from 5700 to 21000 Mwd/MTU, and reprocessed and refabricated into pellets, was reirradiated for an additional 10000 Mwd/MTU. Postirradiation examination has shown that the second-cycle irradiated UO_2 behaved similarly to production grade UO_2. Some reduction in thermal conductivity may have occurred, however. The second-cycle irradiated UO_2 was reprocessed and refabricated into pellets. Pellet densities, calculated from gas displacement and geometrical measurements, varied from 92 to 97, and from 92 to 95% of theoretical. Water displacement densities were 96 to 97% of theoretical. Radiochemical analyses indicated that, except for cesium and noble gases, little or no decontamination occurred. Author

N65-35068*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF A SUBSCALE INTERNALLY INSULATED FIBER-GLASS PROPELLANT TANK FOR LIQUID HYDROGEN
Laurence J. Heidelberg Washington, NASA, Oct. 1965 31 p refs
(NASA-TN-D-3068) CFSTI: HC $2.00/MF $0.50 CSCL 13H

The use of fiber-glass-reinforced plastics as a structural material, in conjunction with internally located foam insulation for liquid-hydrogen propellant tanks, was investigated by designing, fabricating, and experimentally evaluating a subscale tank. The tank consisted of three main components: a structural shell of filament-wound fiber glass, an internal insulation system of polyurethane foam encapsulated in a vacuum-tight jacket of aluminum-Mylar-aluminum foil laminate, and an impermeable liner of the same laminate. Liquid-hydrogen boiloff tests were used to determine the thermal performance and pressure-cycling tests were used to evaluate structural performance. It was found that the internal insulation performed well with a heat flux through the 1/2-inch wall thickness of about 90 Btu/(hr)

(sq ft), corresponding to a thermal conductivity of 0.096 (Btu)(in.)/(hr)(sq ft)(° F). Although liner failure occurred 30 percent below the design pressure of 100 pounds per square inch, design changes were indicated that would substantially increase liner performance. The limited extensibility of the liner limits the use of fiber glass to its full potential. Allowing the liner to wrinkle seems to be a promising solution to the problem. Author

N65-35114*# Hittman Associates, Inc., Baltimore, Md.
THERMOELECTRIC BONDING STUDY Summary Report
Abraham L. Eiss Mar. 1965 63 p refs
(Contract NAS5-3973)
(NASA-CR-67282; HIT-163) CFSTI: HC $3.00/MF $0.75 CSCL 13H

A study was conducted of the bonding process and the bond failure mechanisms in lead telluride thermoelectric elements, and to develop a satisfactory braze and shoe system for the material. Through a literature survey and an analytical evaluation of available metallurgical data, potential braze and shoe materials for use with lead telluride were selected. Screening was done by conducting wettability tests and accelerated poison effects tests. Tin telluride was found to be the braze having the smallest deleterious effect on the thermoelectric properties of lead telluride. A bonding process was developed and elements prepared and evaluated metallographically by bond resistance measurements and by torque tests. A concurrent stress analysis identified the main thermal stress patterns present in bonded thermoelements and showed how they could be applied to the lead telluride bonding problem. Many shoe and braze materials will bond with lead telluride but will not survive for extended periods of time under thermoelectric generator operating conditions. Poisoning by material diffusion into the thermoelectric material and thermal stresses at the bond interface are the two main causes of failure. R.N.A.

N65-35188# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
AN EVALUATION OF ADJUSTABLE SPEED DRIVE SYSTEMS ON MACHINE TOOLS
L. W. Utley 25 Aug. 1965 16 p
(Contract AT(29-1)-1106)
(RFP-562) CFSTI: $1.00

The load versus speed characteristics of three machine tools with different drive systems have been determined. Included are machines driven by hydraulic motor, ac motor, and dc motor. None of these machine tools had a closed loop feedback system to regulate speed as load was applied. Author

N65-35216*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A LONG-TERM ELECTRODE SYSTEM SUITABLE FOR ECG AND IMPEDANCE PNEUMOGRAPHY
J. L. Day and M. W. Lippitt, Jr. [1962] 14 p refs Submitted for Publication
(NASA-TM-X-54630) CFSTI: HC $1.00/MF $0.50 CSCL 06B

Described is an electrode system for sensing bioelectric potentials during space flights. The utilized electrode disc was fabricated from a fine grade silver sheet and fastened to the prepared skin location by tape. An electrode paste with the same ionic content as ten times that of Mamallian Ringer's solution provided low resistance and minimal skin irritation during tests that lasted more than one week. G.G.

N65-35244*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ELECTRON BEAM APPLICATION TO WELDING SPACE PROPULSION COMPONENTS
George Tulisiak Washington, NASA, 1964 19 p Presented at the 6th Symp. on Electron Beam Technol., Cambridge, Mass., 27 Apr. 1964
(NASA-TM-X-52015) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Electron beam techniques for joining components of space engines have been employed for more than three years. Fabrication methods developed include the production of porous tungsten ion emitters, thermionic diode assemblies, and liquid metal heat transfer assemblies. Materials involved in these applications include tungsten, porous tungsten, molybdenum, tantalum, columbium 1% zirconium, columbium, titanium, and stainless steel. Some applications have involved the use of the electron beam for vaporizing metals onto nonmetals. Components produced for Zero G gravity testing required vaporizing tungsten and nichrome materials onto glass and ceramics. Electron beam equipment employed includes both high and low voltage power sources. Author

N65-35320# Space Technology Labs., Inc., Redondo Beach, Calif.
OCTAHEDRAL RESEARCH SATELLITE-MARK II FOR COLDWELDING EXPERIMENTS Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965
[1965] 24 p
(Contract AF 04(611)-9883)
(STL-4169-6012-SU-000; AD-465921)

This report covers the progress toward development, fabrication, and delivery of a satellite for in-space experimentation. The basic experimental objective is to study the phenomenon of coldwelding as it applies to materials in valves of propulsion systems. The satellite system is designed for a subsatellite launch operation where the satellite is carried as an auxiliary payload onboard a primary mission. After attainment of orbital attitude, the satellite is separated from the main spacecraft and performs coldwelding experiments and transmits data independent of any other in-space system. Efforts were directed toward completion of design and development for the entire spacecraft and initiation of fabrication. The scope of this experiment has been expanded. This report reviews the experimental objectives and describes the progress toward final accomplishment of the in-space experiment. Author

N65-35354*# Electro-Optical Systems, Inc., Pasadena, Calif.
HIGH-PERFORMANCE THERMIONIC CONVERTER Quarterly Progress Report, 13 May–13 Aug. 1965
A. E. Campbell and D. H. Pollock 23 Aug. 1965 91 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951225)
(NASA-CR-67299; EOS-6952-Q-1) CFSTI: HC $3.00/MF $0.75 CSCL 13H

Radiator heat rejection studies have been concerned with investigations of coating stability, fabrication of collectors, and high temperature brazing. Rokide "C" coatings of .002" on molybdenum and copper were found to be stable at 600° C for periods in excess of 500 hours. Effective emissivity for these coatings is found to be 0.78, and does not change at 600° C for thicknesses between .002 and .006". There was no peeling, chipping, degradation, or evaporation of these coatings over the 500 hour test in a 10^{-7} mm Hg ion-pumped environment. A copper radiator-molybdenum collector has been fabricated, and testing indicates that it retains the integral strength of the Mb collector-radiator while it is better than Mb on a heat rejection per unit weight basis. An Mb-collector with copper

inserts has been fabricated, and calculations indicate improved effective thermal conductivity of the collector barrel. Rhenium-niobium braze joints, using vanadium as the brazing material, appear to be brittle and do not exhibit any brittle intermetallic compounds when the correct braze schedule is used. M.W.R.

N65-35358*# Auto-Control Labs., Inc., Los Angeles, Calif.
HIGH TEMPERATURE THERMOCOUPLE RESEARCH AND DEVELOPMENT PROGRAM. APPENDIX 3: MISCELLANEOUS TECHNICAL DATA Summary Report
R. R. Smith, Jr. 18 Jun. 1965 78 p refs
(Contract NAS8-5438)
(NASA-CR-67347; T-1097) CFSTI: HC $3.00/MF $0.75 CSCL 13H

Results of a survey of high melting point materials, from 3000° to 6800° F, are listed, and tabulations are also included on the properties of refractory carbides, oxides, borides, and beryllides, and commercial carbides; and on the conversion factors for high temperature properties of graphites. Problems involved in tungsten fabrication are discussed, and results of a compression test on tungsten tubes are given. The attitude of the gauge relative to flow is examined, and figures depict the flow envelope, rhombus in supersonic flow, possible two-dimensional shapes, form drag, and shock drag. Empirical data on high temperature insulators were compiled, and compared with existing published data; a comparison of these values is included. Details are also given on the postmortem examination of two gauges previously tested in a scale rocket engine; on vibration and shock tests of a mock-up sheath used on the gauge; and on the thermal protective mechanisms of oxidation resistant and erosion resistant coatings. M.G.J.

N65-35360*# Mechanical Technology, Inc., Latham, N. Y.
STATIC AND DYNAMIC STIFFNESS AND DAMPING OF THE SOURCE FED ANNULAR THRUST BEARING
J. W. Lund Oct. 1963 53 p
(Contract NAS8-5154)
(NASA-CR-67345; MTI-63TR44) CSCL 13I

A method is presented for calculating the static and the dynamic stiffness and damping of the orifice restricted, externally pressurized gas thrust bearing. The bearing is an annulus and fed from individual orifices. The orifices are treated approximately as point sources. Assuming the vibratory amplitude to be small compared to the clearance a finite difference procedure is used to solve Reynolds equation for the pressure developed in the film. A computer program has been written and gives the results in dimensionless form as functions of 2 variables (possibly 3 variables), namely flow parameters and a frequency number. The procedure for obtaining actual bearing data from the dimensionless results is described. Finally, it is shown how the results may be presented in concise, readily used design charts with a minimum number of graphs. It is also indicated how the calculations may be used to determine the threshold of instability. The report includes instructions for preparing the computer input and input forms. Author

N65-35412*# Auto-Control Labs., Inc., Los Angeles, Calif.
HIGH TEMPERATURE THERMOCOUPLE RESEARCH AND DEVELOPMENT PROGRAM Summary Report
R. R. Smith, Jr. 18 Jun. 1965 34 p
(Contract NAS8-5438)
(NASA-CR-67348; T-1097) CFSTI: HC $2.00/MF $0.50 CSCL 13H

The thermocouples were similarly constructed, with a thermochemically formed tungsten sheath and a tungsten 26% rhenium center conductor arranged in a coaxial fashion. Stem length of the thermocouples were fixed at 1.8 inches. Constituents within the family of thermocouples were operated at 3000° C, for short periods of time, in the order of seconds rather than minutes. Test probes run in a gas burner lasted for appreciable periods of time, in the order of minutes, under highly oxidizing and erosive conditions. Separate shock (60g 11 ms) and vibration tests to the 50 g level at 2000 cps demonstrated that the probes met the shock and vibration requirements. It was concluded that the type 4735 probes were capable of short term operations at temperatures in the 5000° F region, and for longer term operation in the 4000° F temperature range. The probe structure was capable of withstanding the vibratory and shock loadings specified, and the dynamic loads imposed on it by immersion in a steady high velocity gas stream. R.W.H.

N65-35415*# Auto-Control Labs., Inc., Los Angeles, Calif.
HIGH TEMPERATURE THERMOCOUPLE RESEARCH AND DEVELOPMENT PROGRAM. APPENDIX 2: CALIBRATIONS
R. R. Smith, Jr. 18 Jun. 1965 99 p
(Contract NAS8-5438)
(NASA-CR-67197; T-1097) CFSTI: HC $3.00/MF $0.75 CSCL 13H

A series of calibration runs were made in a low temperature oven to establish calibration of a gauge. Two gauges were available for calibration and test at 5400° F. The principle difference between the two was a greater wall thickness in the second generation gauge sheaths. Also, the effect of different types of compensated lead wire on the output of the gauges were determined. R.W.H.

N65-35416*# Auto-Control Labs., Inc., Los Angeles, Calif.
HIGH TEMPERATURE THERMOCOUPLE RESEARCH AND DEVELOPMENT PROGRAM. APPENDIX I: DRAWINGS AND DESIGN NOTES
R. R. Smith, Jr. 18 Jun. 1965 33 p
(Contract NAS8-5438)
(NASA-CR-67196; T-1097) CFSTI: HC $2.00/MF $0.50 CSCL 13H

Details of fabrication are shown for all three classes of gauges. They consist of piece part drawings, assembly drawings, and outline drawings. The drawings are grouped in three categories: mandrel parts and assembly; and first and second generation parts and assemblies. A separate set of parts drawings for the third generation gauges was not necessary because mandrels, body piece parts, and sheaths were identical to the second generation parts. R.W.H.

N65-35425# Army Materiel Command, Washington, D. C.
AMC NONDESTRUCTIVE TESTING INSPECTION REGULATION. VOLUME 2: ELECTROMAGNETIC INSPECTION
Dec. 1964 204 p refs
(AMCR-715-501, Vol. 2)

The purpose of this volume on Electromagnetic Inspection is to provide Army Materiel Command quality assurance personnel with the basic principles underlying electromagnetic inspection techniques. The subject matter covered includes a brief history of the development of electromagnetic inspection technology, the theory and principles of electromagnetic testing and test systems, calibration and quality assurance standards, and typical applications of testing techniques. A glossary of electromagnetic testing terms and an appendix of symbolic

definitions are provided for the benefit of the reader; a bibliography covers some of the more pertinent references current in the field of electromagnetic testing. It is intended that this volume serve as a reference in which answers may be found to the more general questions concerning the technical aspects and applications of electromagnetic inspection. Author

N65-35473# Lund Inst. of Tech. (Sweden).
ON HYDRODYNAMIC LUBRICATION WITH SPECIAL REFERENCE TO SUB-CAVITY PRESSURES AND NUMBER OF STREAMERS IN CAVITATION REGIONS
Leif Floberg Stockholm, Royal Swed. Acad. of Eng. Sci., 1965 37 p refs *Its* Acta Polytechnica Scandinavica, Mech. Eng. Ser. No. 19
(UDC-621.89.032) CFSTI: HC $2.00/MF $0.50

Hydrodynamic lubrication of two lightly loaded rotating circular cylinders is studied. Special reference is here given to sub-cavity pressures and number of oil streamers in cavitation regions. It is shown both theoretically and experimentally how the sub-cavity pressure will influence the number of streamers and the other bearing quantities. The agreement between theory and tests is quite satisfactory. It is shown that the influence of the surface tension can be neglected even at extremely light loads. Calculations are made for pressure distributions, load capacities, and oil flows. Tests are carried out for pressure distributions, load capacities and meniscus locations. Photos are taken showing the cavitation boundaries. Author

N65-35475*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STUDIES OF LUBRICATING MATERIALS IN VACUUM
Robert L. Johnson, Donald H. Buckley, and Max A. Swikert [1964] 32 p Presented by the USAF–Southwest Res. Inst. Aerospace Bearing Conf., San Antonio, 25–27 Mar. 1964
(NASA-TM-X-54555) CFSTI: HC $2.00/MF $0.50 CSCL 11H

Evaporation rate, friction, and wear investigations were conducted for studying the properties of lubricating materials in vacuum conditions. Evaporation rates for three polytetrafluoroethylene (PTFE) compositions were determined. The materials examined were an extruded PTFE composition and two molded materials. Results indicate that all three components exhibited lower evaporation rates at the higher temperatures than did a commercial PTFE composition. The extruded composition exhibited a higher evaporation rate than the two molded compositions. It is indicated that if minimum evaporation rate is required, the molded compositions may be more desirable. The evaporation rates for two epoxy compositions were also determined. Friction and wear studies in vacuum conditions explored the behavior during sliding contact for a series of polymeric compositions, binary alloys containing soft film-forming phases, complex alloys with film-forming materials, and a burnished MoS_2 film. A burnished MoS_2 film applied to type 440-C stainless steel in argon with a rotating soft wire brush had good endurance properties but somewhat higher friction than commerically available bonded films. L.S.

N65-35679# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
A BASIS STUDY OF THE SLIDING CONTACTS IN ROLLING BEARINGS Summary Report, 16 Apr. 1964–16 Apr. 1965
C.J. Belsky, J. I. Mc Cool, J. T. Walker, J. A. Kamenshine, K. Tatiahet al [1965] 126 p refs
(Contract NOw-64-0428-c)
(AL65L045; AD-617735)

Smearing in Hertzian contacts made of hardened steel with severe wear occurrences involving macroscopic metal transfer between the surfaces are under study. It was found that a single sliding Hertzian contact between two hardened and lapped steel balls, taking place under carefully standardized conditions of sliding speed and heat balance, with a well defined oil lubricant introduced in a standardized manner, makes the transition between mild wear and smearing at a load repeatable within 15% from test to test, provided that the onset of smearing is sensitively detected from the accompanying abrupt increase in contact friction. Also discussed were test lubricants, speeds, torque, and loads measured on the two-ball tester at the inception of smearing in pure sliding. The average skew angle of each roller was plotted for four gage positions. A bearing was tested under no intentionally induced misalignment and the average skew angles shown were obtained from X–Y plots. A plot of average skew angles that were obtained with the bearing intentionally misaligned were also shown. R.W.H.

N65-35694# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MASS OF A SHAFT AND ITS EFFECT ON THE CRITICAL ANGULAR VELOCITIES OF TURBINE ROTOR
K. A. Kryukov 12 May 1965 14 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 4, 1958 p 101–108
(FTD-TT-64-1054/1+2; AD-617661)

A frequency equation for a system with a heavy shaft is derived by the dynamic pliability method. The equation is used in examples to determine eigen frequencies of a single shaft turbine rotor with and without consideration of shaft weight, and to determine critical angular velocities of a double shaft rotor. It was found that disregard of shaft mass when calculating critical velocities in double shaft systems of turbojet and turboprop engines, and also in single shaft dual support systems, can lead to considerable errors. J.M.D.

N65-35732# Air Force System Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF ADDITIVES ON THE ANTIWEAR PROPERTIES OF FUELS
G. I. Kichkin, I. Z. Rozhkov, A. V. Vilenkin, and Ye. N. Kornilova 11 Feb. 1965 15 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 6, 1963 p 60–65
(FTD-TT-64-937/1+2; AD-611531)

The effects of different additives on the antiwear properties of type T fuel were studied by a friction machine containing a disc and a cylindrical roller as the pressurized rubbing pair. Quantitative antiwear properties of the fuels were determined from the amount of load at which the breakdown of the lubricating fuel layer occurred. The antiwear properties of the fuel deteriorated considerably with a temperature rise from 20 to 150° C. Small concentrations of antiwear substances developed from oils improved the fuel antiwear properties almost to the same level as additions of oxidizers or stabilizers. Additions of phenols, alkylphenols, and phenylene–diamines improved fuel stability during storage as well as the antiwear properties. G.G.

N65-35752# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CASTING BY METHOD OF VACUUM SUCTION
B. M. Ksenofontov 22 Jan. 1965 211 p refs Transl. into ENGLISH of the book "Lit'ye Metodom Vakuumnogo Vsasyvaniya" Moscow, Gos. Nauch.-tekhn. Izd., 1962 p 1–168
(FTD-TT-64-238; AD-610767)

Theoretical and technological bases of vacuum suction processes for the production of castings and ingots from copper alloys are presented. The installation of new machines for the manufacture of castings and ingots by the suction method is considered. The effectiveness of the process and directions for its further development are illuminated. Author

N65-35756# Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
PYROLYTIC COATING OF CARBON FILAMENTS Technical Documentary Report, 15 May 1963–15 May 1964
Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 160 p refs
(Contract AF 33(657)-11297)
(ML-TDR-64-297; AD-608764)

A continuous process has been developed to coat the individual filaments of graphite yarn with pyrolytic graphite. The pyrolytic coating increased the strength-to-weight ratio of the filaments by a factor of 1.3 and acted as a sizing on the yarn to make weaving easier. Tapes woven from the coated yarn showed a load distribution factor as high as 0.9. Author

N65-35765# Northrop Corp., Hawthorne, Calif. Norair Div.
TANTALUM AND MOLYBDENUM BRAZING TECHNIQUES Quarterly Progress Report No. 6, Jan.–Mar. 1965
A. H. Freedman, L. H. Stone, and E. B. Mikus Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1965 24 p refs
(Contract AF 33(657)-11227)
(NOR-65-68; AD-615452)

During this reporting period, effort was devoted to determining the reusability of titanium-base diffusion sink systems at 3000° F and the Hf–40Ta conventional braze alloy at 3500° F on Ta–10W honeycomb structures. Low volatile and volatile-free diffusion sink braze systems for Ta–10W honeycomb were screened for applicability to 3500° F reusable service. Processing techniques were investigated for improving remelt and service temperature potential of the Ti–25Cr–3Be diffusion sink system for TZM. Precoating of a Ti–50Ta diffusion sink braze joint with vacuum deposited tantalum was investigated as a solution to the coating-braze alloy interaction problem. R.N.A.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-34867# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
DECAY OF LASER-INDUCED EXCITATIONS OF F-CENTERS Technical Report No. 3
Dietmar Fröhlich and Herbert Mahr 30 Jul. 1965 23 p refs
(Contract Nonr-401(47))
(MSC-387; AD-619072)

A strong population of excited F-center states is achieved in various alkali halides using a short intense pulse of a Q-switched ruby laser. During the presence of the excited F-centers the time dependence of their decay is measured with a fast-recording spectrometer. This is done by monitoring the absorption changes connected with the ground state or excited state populations. Using this method for crystals containing low F-center concentrations the lifetime of the excited state of F-centers in KI, RbI, CsI, RbBr and CsF is measured from 7° K to about 80° K by monitoring absorption changes in the region of the β-, the β^*- and the F-band, respectively. For KI samples containing high F-center concentrations it is found that the decay curves are nonexponential. Author

N65-34887# Stanford Univ., Calif. Microwave Lab.
MICROWAVE RESEARCH Quarterly Status Report No. 25, 1 Feb.–30 Apr. 1965
Jul. 1965 14 p refs
(Contract Nonr-225(48))
(ML-1351; AD-618709)

Progress is reported on acoustic wave amplification, optical masers, tunable lasers, electron–proton interactions, semiconductors, geometric optics, and solid state plasma studies. Among the specific accomplishments was the investigation of a number of commercial diffused and alloyed planar p-n junctions in which microwave radiation was found. The spectrum of the emitted radiation was estimated to reach as far as 20 to 30 kMc. The power output of these diodes under pulsed operation was of the order of one mW at X-band frequencies. Also, attention was focused on liquids with known Raman characteristics. No Stokes output was observed characteristic of an infrared transition in either benzene or chloroform. Benzene has a molecular center-of-symmetry and therefore no tuning should be possible. E.E.B.

N65-35043# Library of Congress, Washington, D. C. Aerospace Technology Div.
DIFFRACTION SYNCHRONIZATION OF LASERS Translations of Soviet-Bloc Scientific and Technical Literature
N. G. Basov et al 16 Jul. 1965 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 161, no. 3, 1965 p 556–559
(ATD-T-65-47; AD-618389)

Conditions are given for the existence of a radiating mirror laser in which a semiconducting layer is applied directly to the mirrors of the resonator; the said layer being divided by absorbing partitions into separate isolated cells. Such an arrangement increases the efficiency of large semiconductor lasers while suppressing parasitic generation in the plane of the mirror. The diffraction coupling coefficient of open resonators is calculated, and the stability conditions of the synchronized system are determined. TAB

N65-35355*# Hughes Research Labs., Malibu Beach, Calif.
INVESTIGATION OF THE DC-EXCITED XENON LASER Final Report, 24 Mar. 1964–24 Mar. 1965
Peter O. Clark, Richard A. Hubach, and James Y. Wada Apr. 1965 81 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950803)
(NASA-CR-67298) CFSTI: HC $3.00/MF $0.75 CSCL 20E

Electron energy distributions in helium-neon and xenon gas laser discharges are found to be nearly Maxwellian for small values of R_p, a product of the radius and the pressure. For larger R_p values, distributions deviate strongly from the Maxwellian. Plasma boundary effect and electron-neutral elastic collisions, the most important factors in forming the electron energy distribution in laser discharges, are theoretically formulated by consideration of energy conservation. The theory explains the observed dependence of the distribution as a function of R_p, and experimental results are in reasonable agreement with this theory. Among the new discharge configuration designed and constructed were three hollow cathode discharge

tubes and a pentode laser. None of these produced measurable output power or gain at 3.5080 μ even though they required a much larger input power than glow discharge tubes of comparable size. It was, therefore, concluded that the standard dc-excited glow discharge is the most effective and efficient gas laser discharge. M.W.R.

N65-35449# Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sciences Lab.
A LASER FOR AN EARTH-BASED SATELLITE ILLUMINATOR
Robert L. Iliff Jun. 1965 24 p refs *Its* Instrumentation Papers No. 70
(AFCRL-65-442; AD-619342)

A 250-joule, liquid-nitrogen cooled, ruby laser has been used to illuminate a specially equipped satellite, Explorer 22, with sufficient intensity to photograph the cube corner reflectors located on the satellite. The laser system including the photoreceiver is described. A simple method of aligning the optic axis with a known azimuth is presented. Some laser experiments designed to lengthen the lifetime of the laser and to optimize the output energy are also given. Author

N65-35528# Precision Instrument Co., Palo Alto, Calif.
COHERENT-LIGHT RECORDING TECHNIQUES Final Report, 1 Jan.–31 Dec. 1964
C. H. Becker Griffiss AFB, N. Y., RADC, Jun. 1965 145 p refs
(Contract AF 30(602)-3272)
(RADC-TR-65-130; AD-618919)

Coherent-light recording/reproducing comprises a two-dimensional quantum-mechanical data process of ultimate packing density and frequency bandwidth. It is based on a continuous-wave single-mode (TEM_{oo}) laser as the coherent light source for recording and reproducing. Photographic coherent-light recording uses high-resolution microfilm as the recording medium. Diffraction-limited images of the laser are focused, electro-optically modulated, and swept over the photographic film. A photographic negative of the recordings is reproduced by means of a coherent-light beam of the same wavelength used for recording, but of strongly reduced intensity. The feasibility of electro-optical scanning for coherent-light recording/reproducing is investigated theoretically and experimentally. Single-crystal barium titanate in the paraelectric phase is used as wide-angle deflector material. A conventional servo control system is simulated, adjusting recording and reproducing to real time. Author

N65-35530# General Precision, Inc., Pleasantville, N. Y. GPL Div.
PUMPED TRANSFORMER LASERS Technical Summary Report No. 1, 1 Nov. 1964–1 May 1965
Cecil B. Ellis 17 May 1965 158 p refs
(Contract Nonr-4718(00); ARPA Order 306; Proj. Defender)
(GPL-A-31-1; AD-618896)

A new concept is presented and its analysis begun: the TRANSFORMER LASER. This arrangement is intended to convert the outputs from many lesser, and lower quality, auxiliary lasers into a single coherent plane-wavefront by absorption and re-emission in the normal transitions of a molecular gas medium. Work during this contract period has dealt exclusively with analyses of suitable gaseous media to be pumped by a battery of Nd-glass lasers near 1.06μ. The most promising gas molecule found so far for this purpose is CN, which would be obtained from the preparatory exposure of normal $(CN)_2$ gas to a pulse of UV light. The analysis to date indicates a probable potential for operation at very useful power densities, but only a few of the possible questions about such a system have yet been explored. Alternative choices for the gas medium might be Cs_2 or metastable nitrogen molecules. Further analysis of these molecules as well as of CN is planned for the next period. Author

N65-35553# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
FREQUENCY BEATS IN THE OFF-AXIS MODES OF RUBY LASERS
Donald Theodore Davis and R. J. Collins [1965] 63 p refs
(Contract Nonr-710(61))
(TR-3; AD-618633)

The main purpose was to observe the beat frequencies between off-axial modes, and see how parameters such as pump power and nonuniform reflectivity affect them. The microwave frequency beats between these optical laser modes are measured with a photodiode and compared with the values predicted by ideal cavity resonator theory. The observed values are seen to agree very well with those predicted. By selecting the proper nonuniform mirror reflectivity pattern, it was hoped that the thresholds of oscillation could be lowered for the local modes desired. Four different silvering patterns were used on the cylindrical ruby rods. The results indicate that it is possible to lower substantially the thresholds of oscillation of preselected modes with a proper choice of mirror silvering pattern, as long as the average reflectivity of the mirrors is not too drastically reduced. Author

N65-35642# Army Electronics Labs., Fort Monmouth, N. J.
FURTHER CONSIDERATIONS ON REGENERATIVE RUBY LASER AMPLIFIERS
H. Jacobs, F. A. Brand, C. Lo Cascio, G. Novick, J. Castro (Argentine Army) et al Mar. 1965 39 p refs
(ECOM-2575; AD-615112)

A theoretical and experimental study has been carried out on laser amplification. An ideal laser amplifier was previously treated as a three-medium transmission system in which an electromagnetic wave was considered to travel through air, then through an active crystal during which time it underwent multiple internal reflections and finally through air again, all in a direction normal to the planar surfaces of the solid material. Experiments have been initiated to investigate the validity of the theory using ruby at liquid nitrogen temperatures. A transmission system was set up and by controlling the relative time delays in firing both rods, the properties of transmitted power gain were studied. It was found that both the oscillator and amplifier rubies when uncoated, could be made to oscillate for about 100 μsec giving a well-defined pulse of quasi CW operation. The gain of the amplifier increased as the times of the input signal from the oscillator approached the time at which the amplifier went into oscillation. With delay in signal relative to the amplifier oscillation period, an attenuation in transmission was observed. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-34780 Joint Publications Research Service, Washington, D. C.
X-RAY INVESTIGATION OF THE STRUCTURAL CHANGES OF AN Al-Zn(7.49%)-Mg(1.47%) ALLOY DURING LOW TEMPERATURE AGE-HARDENING (I)
Ping-Ch'ing Chang, Ch'ing-T'ang Ch'ueh, and Hsi-K'un Chu *In its* Transl. on Communist China's Sci. and Tech. 13 Sep. 1965 p 11–17 refs Transl. into ENGLISH from Pei-ching Ta-hsueh Hsueh-Pao (Peking), v. 10, no. 2, May 1964 p 165–168 (See N65-34778 22-34) CFSTI: $2.00

The structural changes of Al-Zn-Mg single crystals during the age-hardening process were studied by radiation methods. The following two types of X-ray photographic methods were used: (1) Laue patterns, using W target; and (2) monochromatic and multicolored stationary photographs. Results for specimens quenched in water after 460° C treatment for one hour, for specimens age-hardened at 90° C for three days, and of specimens age-hardened at 200° C for six hours are shown. Laue diffraction patterns established the existence of a small sheet of precipitate parallel to the (111) plane of the basic body during the initial stage of age-hardening. Monochromatic and multicolored crystal photographs found diffraction spots of (001), (100), etc., which are not accounted for by the habit planes. According to calculations, the positions of these new diffraction spots correspond to the positions of the more intense Debye rings (201) and (101) of $MgZn_2$. This fact indicates that under age-hardening temperature conditions the G.P. region is replaced by a new phase. G.G.

N65-34789# Nuclear Metals, Inc., Concord, Mass.
TECHNICAL PAPERS OF THE EIGHTEENTH METALLOGRAPHIC GROUP MEETING
H. Roth Roman, comp. Aug. 1965 215 p refs Meeting held at Atomics Intern., Canoga Park, Calif., 22–24 Jun. 1964 (NMI-5025, Pt. I) CFSTI: $2.25

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7. GRAIN SIZE STANDARDS FOR BETA HEAT-TREATED URANIUM FUEL CORES M. H. Cornett (Natl. Lead Co.) p 105–109 (See N65-34796 23-22)

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9. MICROSTRUCTURAL STUDIES OF CAST URANIUM-BASE ALLOYS J. W. Colby and W. N. Wise (Natl. NIUM A. A. Bauer, C. R. Thompson, and M. S. Farkas (Battelle Memorial Inst.) p 127–151 ref (See N65-34798 23-17)

10. A BRIGHT FIELD ETCH FOR ALPHA-PLUTONIUM V. W. Storhok, R. H. Snider, and M. S. Farkas (Battelle Memorial Inst.) p 153–154 (See N65-34799 23-17)

11. MODIFICATION OF AN ATTACK-POLISH PROCEDURE M. H. Cornett and E. L. Schaich (Natl. Lead Co.) p 155–157 (See N65-34800 23-15)

12. ELECTRON METALLOGRAPHY OF PYROLYTIC CARBON COATINGS ON FUEL PARTICLES C. K. H. Du Bose and J. O. Stiegler (Oak Ridge Natl. Lab.) p 159–171 refs (See N65-34801 23-15)

13. IN-CELL VACUUM IMPREGNATION OF METALLOGRAPHY SPECIMENS F. L. Cochran and H. E. Shoemaker (Gen. Dyn. Corp.) p 173–183 ref (See N65-34802 23-15)

14. VIBRATORY GRINDING AND POLISHING OF METALLOGRAPHIC SPECIMENS S. Matras (Argonne Natl. Lab.) p 185–219 refs (See N65-34803 23-15)

N65-34790 General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
METALLOGRAPHIC AND CERAMOGRAPHIC PREPARATION OF NUCLEAR MATERIALS
E. W. Filer, C. A. Asaud, K. Lacefield, and R. B. Kull *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 1–25 refs (See N65-34789 23-17) (Contract AT(40-1)-2847) CFSTI: $2.25

The polishing and etching procedures for preparing metallic, ceramic and cermet specimens of nuclear materials are discussed with some typical examples of the excellent results obtained. The attack-polishing method was successfully adapted to automatic polishing allowing more pressure to be applied to the specimen. This modification has eliminated the difficulties normally encountered in the preparation of specimens containing materials of extreme variations in hardness. The advantages of this technique are discussed. Author

N65-34791 Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research and Dept. of Metallurgy.
ELECTROPOLISHING THE RARE EARTH METALS
D. T. Peterson and E. N. Hopkins *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 27–37 refs Sponsored by AEC (See N65-34789 23-17) CFSTI: $2.25

This paper describes a method whereby the rare earth metals can be consistently electropolished and chemically etched. The method involves cooling an alcohol-perchloric electrolyte to −76° C before electropolishing. The metals are chemically polished in the same solution. Author

N65-34792 Battelle Memorial Inst., Columbus, Ohio.
METALLOGRAPHY OF CERAMIC FUEL AND REFRACTORY METAL COMPATIBILITY COUPLES
F. E. Mc Grath, J. A. De Mastry, and M. S. Farkas *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 39–58 refs (See N65-34789 23-17) CFSTI: $2.25

The simultaneous compatibility of refractory claddings with UC, UN or UO_2 and liquid lithium or cesium vapor has been determined by metallographic examination of heated compatibility assemblies. Author

N65-34793 Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
METALLOGRAPHIC PREPARATION OF DICARBIDES OF THORIUM AND THORIUM-URANIUM

T. M. Kegley, Jr. and B. C. Leslie *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 59–83 refs Sponsored by AEC (See N65-34789 23-17) CFSTI: $2.25

Because of the strong tendency of ThC_2 and $(Th,U)C_2$ to hydrolyze, special techniques were required to metallographically prepare these carbides. Procedures developed included vibratory polishing inside a dry box and mechanical polishing outside a dry box. Pyrolytic carbon-coated particles and arc cast specimens were prepared using these procedures. Instead of the customary air etching, specimens were etched by immersing 1–5 min in 1:1 HNO_3–H_2O. The 1:1 HNO_3–H_2O solution passivates the polished surface presumably by forming a protective film which prevents reaction with moisture during the period required for microscopic observation and photomicrography. Short periods (1/2 to 1 min) of immersion in the 1:1 HNO_3–H_2O solution produced a passivated surface, while longer periods (5 to 45 min) etched the dicarbide specimens. Polarized light was particularly effective for observing the twinned structures of the dicarbides. Author

N65-34794 Atomics International, Canoga Park, Calif.
QUANTITATIVE METALLOGRAPHY OF HYPOSTOICHIOMETRIC URANIUM MONOCARBIDE
E. E. Ritchie and J. L. Tibbetts *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 85–95 refs (See N65-34789 23-17) CFSTI: $2.25

A compilation of data obtained from three statistical test methods for determining the amount of excess alpha uranium present in hypostoichiometric uranium carbide are presented. The test methods employed were: (1) superimposing a grid on several areas of a photomicrograph and counting the number of grid intercepts falling on alpha uranium, (2) comparison of metallographically prepared microstructure to photomicrographs of standards with known carbon contents, and (3) chemical carbon analysis of the material. Among the conclusions obtained from the evaluation are that precision of both the grid intercept and the metallographic comparison methods increase with increasing carbon content, precision also increases with an increasing number of samples, and no significant variation was observed between evaluations made by two metallographers. C.T.C.

N65-34795 National Lead Co., of Ohio, Cincinnati.
STANDARDS FOR METALLOGRAPHIC EVALUATIONS OF URANIUM METAL
M. H. Cornett *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 97–103 (See N65-34789 23-17) CFSTI: $2.25

Visual standards are presented for rating the degree of recrystallization of formed uranium metal, the inclusion content of as-cast uranium metal, and the inclusion and stringer content of formed uranium metal. Author

N65-34797 National Lead Co. of Ohio, Cincinnati.
ELECTRON MICROPROBE STUDIES OF DILUTE URANIUM-BASE ALLOYS
J. W. Colby and W. N. Wise *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 111–125 refs (See N65-34789 23-17) CFSTI: $2.25

This paper describes some preliminary studies of uranium employing microprobe analyzer. In particular, the results of studies on solid metal and shot containing phosphorus additions, and on uranium shot containing zirconium additions, are described. Results from a study of cladding failures of some Mark V–E fuel cores are also discussed. Author

N65-34798 Battelle Memorial Inst., Columbus, Ohio.
MICROSTRUCTURAL STUDIES OF CAST URANIUM
A. A. Bauer, C. R. Thompson, and M. S. Farkas *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 127–151 ref (See N65-34789 23-17) CFSTI: $2.25

In this report the results of a brief program which was undertaken to evaluate the use of metallographic and electron microscopic techniques in detecting microstructural differences in cast uranium of varied chemistry and casting history are described. Of particular interest was evidence of differences in substructure and in fine-particle distribution and form between the various materials. The major accomplishment was the development of suitable techniques. The effectiveness of these techniques is illustrated by a series of micrographs from which some preliminary conclusions concerning the effects of chemistry and casting history on microstructure have been drawn. Author

N65-34799 Battelle Memorial Inst., Columbus, Ohio.
A BRIGHT FIELD ETCH FOR ALPHA-PLUTONIUM
V. W. Storhok, R. H. Snider, and M. S. Farkas *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 153–154 (See N65-34789 23-17) CFSTI: $2.25

It is reported that an etch for metallographic examination of alpha-plutonium has been developed which produces a fine, delineated microstructure under bright field illumination. The etchant, which is used electrolytically, consists of 75 cc ethyl alcohol, 20 cc nitric, and 5 cc water. C.T.C.

N65-34854# Columbia Univ., New York. Inst. for the Study of Fatigue and Reliability.
ON SECOND ORDER STRAIN ACCUMULATION IN ALUMINUM IN REVERSED CYCLIC TORSION AT ELEVATED TEMPERATURES
Maria Ronay Jun. 1965 74 p refs
(Contract Nonr-266(91))
(TR-22; AD-470068)

Experiments on superpure aluminum in reversed cyclic torsion at elevated temperatures showed that the second order axial elongation of the specimen is increasing with increasing temperature in the 100° to 300° C. temperature range. The quadratic relation between the accumulated second order strain increments and the applied shear strain amplitude already found at room temperature holds at each elevated temperature investigated. The second order strain increment is a function of the applied shear strain amplitude, previous number of cycles and temperature. The cycle and temperature effects can be separated, the temperature function being exponential. A fictitious activation energy was calculated for the second order extension of aluminum ("cyclic creep") and was found to be almost one order of magnitude smaller than the activation energy of static (high temperature) creep, showing that different material parameters are involved in the two phenomena. The relation between first order cyclic recovery and second order strain accumulation was established. Author

N65-34886# Honeywell, Hopkins, Minn. Research Center.
MECHANICAL BEHAVIOR OF POLYCRYSTALLINE MAGNESIUM OXIDE AT HIGH TEMPERATURE Technical Report No. 30
R. B. Day and R. J. Stokes Jul. 1965 55 p refs
(Contract Nonr-4076(00))
(HR-65-269; AD-619369)

This paper describes high temperature tensile deformation of polycrystalline magnesia prepared by (a) single crystal recrystallization and (b) hot pressing. Recrystallized polycrystalline magnesia goes through a brittle-ductile transition at 1700° C (strain rate 10^{-4} sec^{-1}). The brittleness below 1700° C is due to a lack of slip systems and grain boundary sliding. At 1700° C grain boundary migration produces corrupgations in the interface which interfere with sliding. About 1700° C the matrix becomes sufficiently plastic through multiple slip and polygonization to accommodate any distortion. Polycrystalline specimens then neck down for completely ductile fracture. Hot pressed magnesia starts to go through a transition at 2200° C, i.e., 500° C higher. The increase is attributed to the presence of pores and impurity. Porosity is considered to promote grain boundary sliding by (a) providing source for intergranular sliding, (b) decreasing the interfacial contact area, (c) preventing grain boundary migration and corrugation. These observations confirm that high temperature deformation occurs by dislocation glide and climb and grain boundary sliding and migration. Author

N65-34888# IIT Research Inst., Chicago, Ill. Metallurgical Engineering Dept.
SHORT-RANGE FORCES IN ALLOYS Summary Report
Leonid V. Azaroff 15 Jul. 1965 8 p refs
(Contract Nonr-1406(07))
(AD-618132)

The feasibility of using X-ray spectra to elucidate the phenomena accompanying alloying was established. The validity of the earlier analyses was reconfirmed and several alloy systems were investigated. All results obtained so far clearly indicate that it is possible to interpret the fine structure appearing near the main absorption edge of an atom in terms of the absorbing atom's electronic structure. Once the electronic structure is known, the nature of the interatomic bonds formed can be established and the detailed short-range forces adduced. The copper-rich solid-solution region of the copper–zinc system was examined in order to substantiate the new interpretative procedure which had been previously proposed. TAB

N65-34893# Watervliet Arsenal, N. Y. Benét Labs.
A SURVEY OF ALLOY-EUTECTIC SOURCES FOR ALIGNED STRUCTURES
Richards H. Harrington Jul. 1965 37 p refs
(WVT-6523; AD-618998) CFSTI: $1.00

A nearly complete evaluation of known binary alloy eutectic systems has been made with the exceptions of incomplete listing of Rare Earth Metals and of Refractory Metals. Seventy-seven eutectic systems are listed as unfavorable for production of useful whisker (or aligned) structures. Twenty-eight binary eutectic systems are listed as being possible sources for beneficially aligned structures. Some limitations are discussed. The relative value of using high pressure to increase yield quantities is indicated for specific systems. The high cost for high pressure yields does not appear warranted in any case, (at least for sometime to come). Author

N65-34913# Pratt and Whitney Aircraft, Middletown, Conn.
ELECTRON METALLOGRAPHY TECHNIQUES APPLIED TO BODY CENTERED CUBIC METALS AND ALLOYS
W. A. Keegan, A. V. Karg, and D. E. Fornwalt 30 Jul. 1965 23 p refs
(Contract AT(30-1)-2789)
(TIM-943)

Equipment, etchants and techniques used in preparing specimens of body centered cubic metals for examination by transmission electron microscopy are described. Transmission electron photomicrographs of thin foils prepared by the method described are presented. Author

N65-35008# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
RESEARCH INTO ZIRCONIUM ALLOYS RESISTANT TO CARBON DIOXIDE UNDER PRESSURE AT TEMPERATURES OF UP TO 600°C [RECHERCHE D'ALLIAGES DE ZIRCONIUM COMPATIBLES AVEC LE GAZ CARBONIQUE SOUS PRESSION JUSQU'A 500 OU 600°C]
P. Baque, R. Dominget, and J. Bossard 1963 79 p refs In FRENCH; ENGLISH summary
(CAE-2393) CFSTI: HC $3.00/MF $0.75

Zirconium is a metal having a relatively low neutron capture cross-section and a high melting point; it is thus possible to consider its use in particular as a canning material for fuel elements in CO_2-cooled nuclear reactors. A preliminary study of several types of zirconium showed that the metal is already strongly oxidised in this gas at 500° C. The "breakway" phenomenon is generalised; the oxidation rate is then linear and depends on the carbon dioxide pressure. An attempt was therefore made to find binary and tertiary alloys in order to improve the metal behaviour. Several interesting compositions were found: 1, 1.6 and 2.5 percent of copper, 2 percent of vanadium, and 0.05 and 0.5 percent of calcium. Tertiary copper-molybdenum and copper-phosphorus alloys are also less liable to oxidation and in particular do not exhibit the "breakway" phenomenon even after a prolonged treatment at 600° C. Author

N65-35010# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SEARCH FOR AN ANTIFERROMAGNETIC STRUCTURE IN FeAl ALLOY [RECHERCHE D'UNE STRUCTURE ANTIFERROMAGNETIQUE DANS L'ALLIAGE FeAl]
Andrzej Oles Oct. 1964 7 p refs In FRENCH; ENGLISH summary
(CEA-R-2540) CFSTI: HC $1.00/MF $0.50

An ordered FeAl alloy has been studied by neutron diffraction at 293° K and 1.9° K. No superstructure reflexion of magnetic origin appears at these temperatures. Author

N65-35011# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
LOW CONTENT URANIUM ALLOYS FOR NUCLEAR FUELS [ALLIAGES D'URANIUM A FAIBLE TENEUR POUR ELEMENTS COMBUSTIBLES]
Jacqueline Laniesse and Henri Aubert Aug. 1964 51 p refs In FRENCH; ENGLISH summary
(CEA-R-2584) CFSTI: HC $3.00/MF $0.50

A description is given of the structure and the properties of low content alloys containing from 0.1 to 0.5 percent by weight of Al, Fe, Cr, Si, Mo, or a combination of these elements. A study of the kinetics and of the mode of transformation has made it possible to choose the most satisfactory thermal treatment. An attempt has been made to prepare alloys suitable for an economical industrial development having a small α grain structure without marked preferential orientation, with very fine and stable precipitates as well as a high creep-resistance. The physical properties and the mechanical strength of these alloys are given for temperatures of 20 to 600° C. These alloys proved very satisfactory when irradiated in the form of normal size fuel elements. Author

N65-35021# Battelle-Northwest, Richland, Wash. Metallurgy Research Section.
HIGH TEMPERATURE CORROSION OF CANDIDATE ATR STRUCTURAL MATERIALS
L. A. Charlot and R. E. Westerman Sep. 1965 72 p refs
(Contract AT(45-1)-1830)
(BNWL-100)

Research data in support of the Advanced Test Reactor program of compatibility between structural material and gas are presented. The investigations were primarily concerned with the behavior of Hastelloy X-280, a nickel base alloy, and Haynes Alloy 25, a cobalt base alloy, in static atmospheres of oxygen, methane, carbon monoxide, carbon dioxide, nitrogen, flowing helium, and water vapor at temperatures of 2048° and 2192° F. Evaporation rates of the alloys, and corrosion of weldments in contaminated helium were also studied. Kinetic analyses of the gas-metal reactions were based on continuous weight change determinations. Metallography was employed to evaluate the microstructure of the corroded samples. R.N.A.

N65-35037# Solar, San Diego, Calif.
DEVELOPMENT OF COMPOSITE STRUCTURES FOR HIGH-TEMPERATURE OPERATION First Interim Technical Report, 1 Jul.–31 Oct. 1964
M. R. Licciardello, B. Ohnysty, and J. Boland [1964] 46 p refs
(Contract AF 33(615)-1831)
(ER-1480-4; AD-461368)

Investigation of the substrate and overlay materials has started. Alloys of tungsten or tantalum are being investigated to update the survey made during the previous program and reported in Reference 1. Inclusion of W-26Re as a candidate substrate appears warranted. An evaluation of mixtures of thoria/zirconia and thoria/hafnia was initiated, since these mixtures may allow matching of overlay and substrate expansion coefficients. Eutectics were observed with thoria/hafnia as low as 4400 F. Similiar behavior was noted in thoria/zirconia. Design of a full scale test rig has started. A combustion facility burning natural gas, air, and oxygen is being considered. Author

N65-35040# Phillips Petroleum Co., Bartlesville, Okla. Research Div.
EFFECT OF JP-5 SULFUR CONTENT ON HOT CORROSION OF SUPER ALLOYS IN MARINE ENVIRONMENT Progress Report No. 4
H. T. Quigg, E. H. Fromm, and R. M. Schirmer [1965] 120 p refs
(Contract NOw-64-0443-d)
(Rept.-4123-65R; AD-619656)

An experimental investigation was conducted to determine whether the maximum sulfur content of 0.4 weight per cent, currently allowed in grade JP-5 aviation turbine fuel, is a safe level for the protection of turbine blade alloys used in high-performance engines. Four nickel-base alloys (Udimet 500, Inco 713C, IN-100, and SM-200), one cobalt-base alloy (WI-52), and one aluminum coated alloy (MDC-1 on Inco 713C) were exposed to vitiated air from the Phillips 2-inch combustor (60 air-fuel ratio) at high pressure (15 atmospheres), high velocity (685 to 805 ft/sec) during a five hour cyclic test (55 minutes fuel on, 5 minutes fuel off). It can be concluded from these data at gas temperatures above the melting point of Na_2SO_4 (1623 F) that an order of magnitude reduction in the 0.4 weight per cent sulfur limit to 0.04 weight per cent, which approaches the median of domestic production, would not reduce hot corrosion significantly in a marine environment. Rather, with some superalloys, such a reduction would aggravate a problem which already is at a catastrophic level at high "sea salt" concentrations. Aluminum coating of Inco 713C resulted in a material immune to attack under the conditions investigated. Author

N65-35046# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING MECHANICAL AND THERMAL FATIGUE OF METALS BY THE INTERNAL FRICTION METHOD
V. S. Postnikov, I. V. Zolotukhin, and G. A. Gorshkov 26 Mar. 1965 15 p refs Transl. into ENGLISH from Tr. Inst. Met. Akad. Nauk SSSR (Moscow), 1962 p 218–226
(FTD-TT-64-1046/1+2; AD-614019)

This report represents the first effort of using the internal friction method to study mechanical and thermal fatigue of materials. For the beginning were selected pure metals: cadmium, zinc, aluminum and gold. Of the possible internal friction measuring methods for our purpose we used the low frequency method of torsional oscillations of low amplitude. The frequency of oscillations of the sample 100 mm long, profile 0.7 – 1 mm^2, was equal approximately to 1 c. As a measure of internal friction was used the logarithmic damping decrement, divided by π. All measurements on the first pores were made w/o the use of vacuum i.e. in the air. Author

N65-35050# Societa Ricerche Impianti Nucleari, Saluggia (Italy).
STUDY THROUGH MAGNETIC PROPERTIES CHANGES OF FAST NEUTRON IRRADIATION EFFECTS IN HIGH PURITY IRON
A. Ferro, G. Montalenti, G. P. Soardo (Inst. Electrotec. Nazl. G. Ferraris, Torino) Brussels, EURATOM, May 1963 58 p refs
(Contract EURATOM-004-63-10 TEEI)
(EUR-1798-e, EURAEC-1157) CFSTI: HC $3.00/MF $0.50

A group of experiments is reported on the changes of magnetic properties of very high purity iron irradiated with fast neutrons. The maximum permeability of specimen is of the order of 150,000–200,000. The C and N content was about or less than 2 ppm. The specimens have been irradiated under magnetic field instead of being demagnetized before irradiation as in previous experiments. This was aimed to better explain the nature and form of defects induced by irradiation. The results show that the changes of magnetic properties produced by the radiation are sensitive to an applied magnetic field. This proves that the induced defects have a definitive form anisotropy. Author

N65-35070*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A DECADE OF PROGRESS IN REFRACTORY METALS
G. Mervin Ault Washington, NASA, 1965 76 p refs Horace W. Gillett Lecture presented at the 68th Ann. Meeting of the Am. Soc. for Testing Mater., Lafayette, Ind., 15 Jun. 1965
(NASA-TM-X-52135) CFSTI: HC $3.00/MF $0.75 CSCL 11F

The fundamental characteristics of refractory metals for structural applications are reviewed and special problems they present in manufacture, evaluation, and application are discussed. The unique facilities required for their processing and evaluation, a summary of accomplishments in achieving commercial products, and the present status of the most advanced refractory materials in research and development are presented. More refractory metal research is needed for contamination and

stability in long term testing and service, to improve conventional and dispersion strengthened alloys, and heat treatment coupled with process control to improve and tailor properties. The great need in refractory metals is to combine the alloys of today with suitable coatings to permit operation at long times in an air environment. R.N.A.

N65-35089# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMOELECTRIC CHARACTERISTICS OF METALLIC SINTERED ALLOYS ON A TUNGSTEN AND MOLYBDENUM BASE

N. I. Svede-Shvets, Yu. A. Eyduk, V. A. Yenina, L. S. Vodop'yanova, and Yu. V. Trushin 4 Aug. 1965 16 p refs Transl. into ENGLISH from Sb. Tr. Nauchn. Inst. Chernoy Met. (Moscow), no. 30, 1963 p 7–16

(FTD-TT-65-642/1+2+3+4; AD-619334)

To determine the application of electric insulating ceramic materials for high-temperature thermocouples, a control experiment was set up. This experiment confirmed that for thermocouples which measure temperatures higher than 1700° C, the electric insulating properties of the tested materials were insufficient. It was also established that, in an oxidizing medium of approximately 1600° to 1700° C, the air in the pores of the ceramics served as an additional insulator. This experiment emphasized the need for new electric insulating materials for the protection of thermocouples with application to the measurement of very high temperatures. In addition, the thermoelectric properties of many metals were studied in detail. R.W.H.

N65-35092# Materials Research Lab., Inc., Richton Park, Ill.

THE USE OF STRAIN SOFTENING TO IMPROVE THE PROPERTIES OF REFRACTORY METALS Final Report

E. J. Ripling and S. Zager Mar. 1965 46 p refs

(Contract NOw-64-0247-c)

(AD-618925)

The strain softening characteristics of a cold rolled mild steel, the cobalt base alloy V-36 and a number of refractory alloys were investigated. It was found that softening by flexing was able to significantly improve the notch bend ductility and smooth tensile ductility of the steel. The ductility of the cobalt base alloy, on the other hand, was not significantly altered by flexing. Although the smooth bend properties of molybdenum and tungsten were not altered beyond the "as-received" scatter range, flexing produced a significant improvement in the notch bend ductility especially of the 0.5 Ti-Mo alloy. Test results on cold rolled molybdenum sheet also indicate that a stronger product with improved formability could be obtained by substituting cold rolling plus flexing for the present process of warm rolling plus stress relieving. Author

N65-35094# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

MEASUREMENT OF THE STRENGTH OF WHISKERS AND THEIR ROLE IN REINFORCING EXPERIMENTAL COMPOSITES

R. L. Mehan, W. H. Sutton, and J. A. Herzog Jul. 1965 50 p refs

(R65SD28; AD-465992)

This paper discusses the various factors affecting composite strength of whiskers, with the prime emphasis being directed towards their strength and the strength scatter of the whiskers, since this aspect of fibrous composite materials has received relatively little attention. The problem of accurately determining the strength of whiskers is also discussed, along with the difficulties involved and the precautions that must be observed. The necessary characteristics of matrix materials and the whisker-matrix interactions, as they affect composite strength, are also described. It is concluded that the reinforcing strength of the whiskers can be effectively utilized in a suitable matrix material if they are properly oriented in and are well-bonded to the matrix and if the relative number of weak whiskers is small. Author

N65-35102*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

LOW TEMPERATURE MECHANICAL PROPERTIES OF ALUMINUM ALLOY 2219-T87, 0.040-INCH THICK SHEET THROUGH 5.000-INCH THICK PLATE

C. R. Denaburg 14 Sep. 1965 37 p refs

(NASA-TM-X-53332) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The mechanical properties of aluminum alloy 2219-T87 sheet and plate of various thicknesses were determined over the temperature range from ambient through −253° C (−423° F). The ultimate tensile and yield strengths in the longitudinal and transverse direction increased as the temperature decreased. The ultimate tensile strength ranged from 66.4 to 69.4 ksi at ambient temperature and 95.8 to 107.3 ksi at −253° C (−423° F). The yield strength at ambient temperature was between 54.1 and 57.1 ksi; however, at −253° C (−423° F), it ranged between 68.8 and 79.5 ksi. The elongation, in general, increased as the temperature decreased. The tensile strength in the short transverse direction for the two-inch thick plate was 64.0 ksi at ambient temperature and 78.9 ksi at −253° C (−423° F). The elongation was 4.6 percent at ambient temperature and decreased to 1.3 percent at −253° C (−423° F). The tensile strength in the short transverse direction of the five-inch thick plate was 54.6 ksi at ambient temperature and 65.1 ksi at −253° C (−423° F). Elongation was 0.6, 0.2, and 1.6 percent in two inches for ambient temperature, −196° C (−320° F), and −253° C (−423° F), respectively. Author

N65-35112*# IIT Research Inst., Chicago, Ill. Technology Center.

DEVELOPMENT OF SPACE-STAPLE THERMAL-CONTROL COATINGS Triannual Report, Jan. 20–May 20, 1965

G. A. Zerlaut, R. F. Firestone, and W. E. Jamison Jul. 1965 59 p refs

(Contract NAS5-5379)

(NASA-CR-67250; IITRI-C6014-26) CFSTI: HC $3.00/MF $0.50 CSCL 11C

This report describes studies aimed at the development of stable thermal-control coatings with the lowest possible ratio of solar absorptance to infrared emittance. The studies of inorganic pigments involved the screening of several potassium silicate paints pigmented with zinc titanate, zirconia, hafnia-free zirconia, zirconium spinel, and several rare earth oxides (yttrium, lanthanum, and tantalum oxides). The studies of methyl silicone paint confirmed the excellent stability of zinc oxide paints based upon Owens-Illinois type 650 glass resins. Photolysis experiments were carried out on specially prepared methyl silicone polymers by using mass spectroscopy and electron spin resonance techniques. Some differential spectroscopy measurements were performed to provide a basis for eventual correlation of absorption-band development with type of defect and defect location. Author

N65-35120*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

STUDY OF THE GROWTH PARAMETERS INVOLVED IN SYNTHESIZING BORON CARBIDE FILAMENTS First Quarterly Report

A. Gatti, C. Mancuso, E. Feingold, and J. Kitler Jul. 1965 31 p refs
(Contract NASw-1205)
(NASA-CR-67255) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The effects of growth parameters and deposition zone geometry on boron carbide whiskers produced in a graphite resistance furnace are studied. The results, based on several different mandrels and chimney arrangements indicate that the chemical and physical gradients in the furnace are grossly influenced by these geometric parameters. An extended run under standard conditions produced whiskers of an unusual appearance. Characterization of these whiskers in terms of growth direction and degree of crystalline perfection is being completed. Heavy overgrowths appear to be present. In addition, strength values in the order of 20000 psi were obtained in an effort to fabricate B_4C-aluminum composites by hot pressing techniques; and preparations were made for testing an apparatus built to conduct elevated temperature tensile tests of B_4C whiskers. L.S.

N65-35138# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NICKEL-PLATED ALUMINUM IN DEIONIZED WATER, pH 10 NH_4OH AND LiOH AT 330°C
A. B. Johnson, Jr. Sep. 1965 39 p refs
(Contract AT(45-1)-1830)
(BNWL-98)

Aluminum alloys, nickel-plated by chemical deposition (electroless process), were diffusion-bonded and exposed to semistatic deionized water and to dynamic (25 ft/sec) pH 10 NH_4OH and pH 10 LiOH at 330° C. The nickel-plated aluminum was compatible with deionized water and pH 10 NH_4OH, but not with dynamic pH 10 LiOH. Author

N65-35176# Aeronautical Research Council (Gt. Brit.)
EFFECTS OF VARIED LOADING PATHS ON FATIGUE ENDURANCES. PART I: SOME LOAD FATIGUE PROPERTIES OF NIMONIC 90 AT ELEVATED TEMPERATURES
G. P. Tilly London, HMSO, Dec. 1963 46 p refs Supersedes NGTE-M-373; ARC-25880; see X65-15154
(ARC-CP-786; NGTE-M-373; ARC-25880) CFSTI: HC $2.00/MF $0.50

The load fatigue properties of Nimonic 90 have been examined over the nominal speed range of 7 c/hr to 8000 c/min at temperatures between 20° C and 900° C under repeated tension and push/pull test conditions. It was shown that an increase in test frequency resulted in longer lives to failure at the higher temperatures. Push/pull loading was more severe than repeated tension loading at low temperatures, but became less severe at the higher temperature. An increase in testing temperature increased the incidence of intercrystalline failure whilst increase in test frequency decreased it. Author

N65-35218*# Rensselaer Polytechnic Inst., Troy, N. Y. Research Div.
THE USE OF X-RAY SCATTERING TO STUDY THE ANOMALOUS ELASTIC PROPERTIES OF Fe–Ni ALLOYS
J. Lawrence Katz and Ronald H. Wilson 31 May 1964 89 p refs Submitted for Publication
(Grant NsG-100; Contract DA-31-124 ARO(D)-188)
(NASA-CR-58428) CFSTI: HC $3.00/MF $0.75 CSCL 11F

A method for measuring the integrated intensity of Bragg peaks reflected from the face of a large single crystal of nickel–iron alloy mounted on a goniostat at temperatures from 100° to 600° K is described. An expression for correcting these intensities for diffuse scattering is also presented. The X-ray Debye temperatures are calculated from the temperature variations of the Debye–Waller factor, and a comparison is made of the dependence of these Debye temperatures with the temperature dependence calculated from various ultrasonic elastic constant measurements. Agreement was found in the variation of both Debye temperature measurements serving as a check on the method used. It was concluded that the interatomic magnetic exchange energy does not affect the elastic properties of these alloys at frequencies of the thermal waves which are important in the X-ray measurements. It is proposed that the effective value in the ultrasonic measurements is a spatial average of the magnetic exchange energy over the wavelength of the ultrasonic waves. G.A.L.

N65-35240*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROLLING-CONTACT STUDIES WITH FOUR REFRACTORY MATERIALS TO 2000°F
Richard J. Parker, Salvatore J. Grisaffe, and Erwin V. Zaretsky Washington, NASA, 1964 Presented at 11th Joint Intern. Lubrication Conf., Washington, D. C., 13–15 Oct. 1964
(NASA-TM-X-52020) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Four refractory materials were tested in the five-ball fatigue tester to study their behavior under repeated stresses applied in rolling contact: hot-pressed alumina, cold-pressed-and-sintered alumina, self-bonded silicon carbide, and nickel-bonded titanium carbide cermet. The failures that developed in all four materials were shallow, eroded areas of apparent surface origin unlike fatigue spalls found in bearing steels. The load capacity of hot-pressed alumina was the highest of the four materials tested but was only about 7 percent of that of a typical bearing steel. Preliminary tests at elevated temperatures indicated that hot-pressed alumina is capable of rolling-contact operation at temperatures up to 2000° F without gross wear or plastic deformation. Author

N65-35254*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VAPORIZATION OF TANTALUM CARBIDE–HAFNIUM CARBIDE SOLID SOLUTIONS AT 2500° TO 3000°K
D. L. Deadmore [1964] 26 p refs Presented at Am. Ceram. Soc. Meeting, Chicago, 22 Apr. 1964
(NASA-TM-X-51560) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The vaporization rates in vacuum of hot-pressed HfC, TaC, and solid solutions of these two carbides in the temperature range of 2500° to 3000° K were determined by a Langmuir type method. The results show that a composition near 70 mol percent TaC·30 mol percent HfC exhibits the lowest vaporization rate of any composition within this pseudobinary system. Variations in initial sample bulk density and vaporspecie condensation on the furnace wall have negligible effects on the measured vaporization rates. Preliminary information concerning the influence of time on the vaporization rate of selected compositions is discussed. Conf. Author

N65-35282*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A NEW SERIES OF NICKEL-BASE ALLOYS FOR SERVICE ABOVE 1800°F
John C. Freche and William J. Waters 19 Feb. 1964 12 p refs Submitted for Publication
(NASA-TM-X-51536) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Melting and casting procedures, strength and ductility, oxidation resistance, and metallurgy of a new series of nickel-based alloys are discussed. These alloys have a service capability above 1800° F and are castable under argon and need not be vacuum melted. They are suitable for long periods of operation under high stress in oxidizing environments without protective coatings. The alloys are machinable with tungsten carbide cutting tools; however, a preferred method of finishing is by grinding with silicon carbide wheels. Compositions, tensile data, stress-rupture properties, oxidation behavior, and microstructure for these alloys are given. These alloys have potential for a variety of structural applications where high strength at high temperature is required. E.E.B.

N65-35294# General Electric Co., Schenectady, N. Y. Research Lab.
INVESTIGATION OF THE BASIC PARAMETERS AFFECTING THE PROPERTIES OF INTERMETALLIC COMPOUNDS Progress Report No. 1, 11 Feb.–11 Jun. 1964
J. H. Westbrook, A. U. Seybolt, and E. R. Stover Jun. 1964 30 p refs
(Contract AF 33(615)-1497)
(Rept.-64-GC-0281M; AD-460869)

Studies of sulfur-induced grain boundary hardening have shown that this effect is due to grain boundary segregation; because of the parallel phenomenology the same basis is inferred for oxygen-induced hardening. The amount of solute necessary is extremely small lying between 2% and 15% of the solubility limit. Quenching temperature and quenching rate have been demonstrated to have important effects on segregation-induced hardening through their effects on solute solubility and vacancy concentration in a manner consistent with a previously proposed model. Small additions of metallic solutes have been found to exert effects on the processing and properties of NiAl (47 A/o Al). Additions of vanadium, titanium, and zirconium at approximately 0.05 to 0.1 A/o eliminate oxygen-induced grain boundary hardening under certain conditions. Other elements—in particular, zirconium, molybdenum, and rhenium—raise the recrystallization temperature by about 200° C. Author

N65-35345# Frankford Arsenal, Philadelphia, Pa.
OPTICAL PROPERTIES OF THE ALPHA PHASE ALLOYS, AgZn AND AgCd
Eugene L. Green Jun. 1965 131 p refs
(FA-R-1765; AD-619381)

Reflectance measurements at near-normal incidence have been performed on chemically polished, annealed, polycrystalline samples of the alloys AgZn and AgCd. The dielectric constants, the coefficients $4\pi k/\lambda$, and the energy loss functions were computed by the Kramers-Kronig method. The results presented graphically in the interval from 2 e.v. to 7 e.v. relate mainly to interband absorption. The trends of the dielectric constants with either zinc or cadmium concentration are basically similar. In the dilute alloys increase of temperature from 110° K to 400° K is equivalent optically to a small increase in IIB atom concentration. The zinc and cadmium alloys are, however, subtly different. The 2.5% AgZn with a sharp E_2 edge and a high peak energy loss function is similar to low energy side of the principal peak. The data for the dilute cadmium alloys suggests that empty states exist just above the low temperature Fermi surface from which transitions may occur to the s band. As the trend of the E_2 peaks with increase of IIB atoms (free electron) concentration follows the change in Fermi energy, so also it is probable that the analogous temperature effects are caused by spread of the Fermi surface in accordance with the Fermi distribution function. Author

N65-35369# Oak Ridge National Lab., Tenn.
RESISTIVITY OF PURE AND DOPED IRON BOMBARDED BY ELECTRONS AT 20°K
Colette Minier-Cassayre 3 May 1965 11 p refs Transl. into ENGLISH from French
(ORNL-TR-613)

From a comparative study of iron bombarded at low temperature by electrons and neutrons, the annealing of defects created was interpreted. The presence of foreign atoms was also included. Author

N65-35396*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
FIBER-METAL COMPOSITES
J. W. Weeton and R. A. Signorelli Washington, NASA, 1965 58 p refs Presented at the 12th Sagamore Army Mater. Res. Conf., Requett Lake, N. Y., 24–27 Aug. 1965
(NASA-TM-X-52123) CFSTI: HC $3.00/MF $0.50 CSCL 11F

The law-of-mixtures relationship is shown to represent the behavior of some fiber-metal composites under room and elevated temperature tensile conditions and under stress-rupture conditions. Deviations from law-of-mixtures behavior are considered in terms of large synergistic reactions or catastrophic damage as well as intermediate degrees of improvement or damage. Development of fiber-reinforced materials is reviewed and the potential of some of these composites is considered. Creep resistant, high strength composites as well as low temperature fiber composites have shown promise. A tabulation is presented of the materials used to study strengthening of tungsten by in situ fibering or by reaction between additives and matrices; and graphs are included to show ultimate tensile strengths, deformation stages of fiber, initial and secondary modulus of elasticity, and yield strength of various copper, silver, tungsten, and/or other composites. Potential tensile strengths of fiber-superalloy composites, superalloys, and dispersion-strengthened alloys are compared; and room temperature tensile strengths of polycrystalline and glassy fibers are graphed. M.W.R.

N65-35418# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
FRACTURE TOUGHNESS OF IRRADIATED PWR HAFNIUM
D. F. Mowbray 10 Sep. 1964 23 p refs
(Contract W-31-109-ENG-52)
(KAPL-3076) CFSTI: $2.00

Fracture toughness tests were conducted on eight single-edge notched specimens (0.232-in.-thick) removed from PWR control rods. Four of the specimens had received a total integrated neutron dosage of 7×10^{21} n/cm^2 (>0.625 ev), and four, 15×10^{21} n/cm^2 (>0.625 ev). The specimens were tested at temperatures between −320° F and room temperature. The results of the tests indicated that it was not possible to determine plane-strain fracture toughness of irradiated hafnium in the available section thickness by the pop-in technique, because of twinning deformation adjacent to the notch tip. The tests did, however, reveal: (1) that irradiated hafnium possesses adequate toughness for current control rod applications, and (2) that there was essentially no difference in the brittle fracture resistance of the material at the two levels of neutron-irradiation dosage. Author

N65-35437# Aluminum Co. of America, New Kensington, Pa. ALCOA Research Labs.
INVESTIGATION OF THE MECHANISM OF STRESS CORROSION OF ALUMINUM ALLOYS Final Report, 6 Dec. 1963–6 Feb. 1965

G. C. English [1965] 109 p
(Contract NOw-64-0170-c)
(AD-615789)

The cathodic protection of 7075 alloy in a corrosive, acid chloride solution was investigated. Subsize tensile specimens for protection were taken in the short-transverse direction from 2-inch thick plate in two tempers, one susceptible to stress corrosion and one not susceptible to this type of corrosion. Considerable evidence indicates that the potential protection reflected metallurgical structure rather than extraneous conditions such as the alkalinity produced by cathodic reactions. For all specimens, general corrosion decreased as cathodic protection was increased, first rapidly, and then gradually. Pitting on a microscopic scale ceased by the time a potential 0.20 to 0.25 volts negative to the free corrosion potential was reached. The results suggest strain induced depolarization of the anodic reaction. Electron microscopic examination of prepolished surfaces of cathodically protected specimens shows promise for relating the depolarization to microstructural features. R.W.H.

N65-35441# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
NOTCH SENSITIVITY OF UNIRRADIATED ZIRCALOY SUBJECTED TO BENDING FATIGUE
D. F. Mowbray 10 Mar. 1965 16 p refs
(Contract W-31-109-ENG-52)
(KAPL-3089)

Fatigue-strength reduction factors (K_f) were determined for thick sections of wrought Zircaloy-4 and Zircaloy-4 weld metal. The experimental investigation was confined to determining K_f at 10^6 cycles and 600F. The specimen loading method used for all tests was pure bending. Specimens were tested which had net section depths of 0.60 and 1.00 in., and notch root radii of 0.0007, 0.004, 0.012, and 0.030 in. The test results indicated that the weld metal was considerably more notch sensitive than the wrought metal. Maximum values of K_f found were ~3.0 for the wrought metal, and ~4.6 for the weld metal. No increase in K_f was observed when the net section depth was increased from 0.60 to 1.00 in. The data obtained are compared with existing thin section notched bending test data and notch sensitivity factor (q) curves are established for both wrought and weld materials. Also, the δ concept for estimating the applicable K_f for crack-like defects was applied to the test results. It was found that δ cannot be treated as a material property for Zircaloy-4. Author

N65-35443# Bureau of Mines, Rolla, Mo. Rolla Metallurgy Research Center.
DETERMINATION OF A PART OF THE MAGNESIUM-ZIRCONIUM LIQUIDUS
R. L. Crosby and K. A. Fowler 1965 23 p refs
(BM-RI-6673)

A part of the liquidus of the magnesium-zirconium system was determined by chemical analysis of suction samples taken from the melt in the approximate temperature range of 850° to 1,450° C. The melt was prepared in a furnace pressurized with an inert gas. The average zirconium value in weight-percent of the liquidus composition at each sampling temperature was 0.96 at 867° C, 1.40 at 1,062° C, 2.05 at 1,262° C, and 2.96 at 1,402° C. The equilibrium solid phase was zirconium. Author

N65-35458# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
FATIGUE CRACK PROPAGATION IN UNNOTCHED AND NOTCHED ALUMINUM ALLOY SPECIMENS
J. Schijve and F. A. Jacobs May 1964 39 p refs Sponsored by Netherlands Aircraft Develop. Board
(NLR-TR-M.2128) CFSTI: HC $2.00/MF $0.50

The growth of fatigue cracks in unnotched and notched specimens of unclad 2024-T3 sheet material was observed through two microscopes during fatigue tests. Two types of notched specimens were used, which were geometrically similar (K_t = 2.66), having a ratio 1:2.5 of their dimensions. The results give information on the crack growth, mainly in the microcrack range, and the magnitudes of crack rates at low and high fatigue loads. The notch and the size effects are discussed and the significance of the test data for these problems is analysed. The difference between the theoretical and the empirical approaches of the problems is emphasized. Author

N65-35462# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
ANALYSIS OF THE FATIGUE PHENOMENON IN ALUMINUM ALLOYS
Jacobus Schijve (Ph.D. Thesis—Delft Univ.) [1964] 68 p refs
CFSTI: HC $3.00/MF $0.75

The fatigue phenomenon in aluminum alloys is analyzed on the basis of empirical evidence derived from the literature and results of some recent NLR test series. Main emphasis is on the aluminum copper alloys (2024-type). It has been attempted to develop a dislocation model which could explain crack nucleation and propagation. The following questions were studied: (1) does crack propagation occur along crystal planes, (2) does it occur in all load cycles, (3) is high-level fatigue fundamentally different from low-level fatigue, (4) how does cyclic strain-hardening occur, and (5) what are the variables controlling the crack propagation? The discussion includes simple dislocation concepts, interactions of slip and precipitated zones, and calculations on shear stress distributions around cracks. The model developed for the fatigue phenomenon is still qualitative. First steps to make it quantitative and difficulties involved are pointed out. New results from microscopic studies on the crystallographic orientation of cracks and the rate of propagation of micro-cracks are presented. Author

N65-35514# European Atomic Energy Community, Brussels (Belgium).
ELECTRON MICROSCOPY OF SAP FOLLOWING TENSILE DEFORMATION OR QUENCHING
E. Ruedl and P. Guyot 1965 34 p refs Presented at the Intern. Powder Met. Conf., New York, 14–17 Jun. 1965
(EUR-2479.e) CFSTI: HC $2.00/MF $0.50

Use is made of transmission electron microscopy to support the mechanisms of plastic deformation of SAP-type alloys. An extruded Al-4 wt.% Al_2O_3 SAP alloy, annealed for 2 hours at + 500° C, was studied either before or after tensile deformation at various temperatures. In the extruded and annealed alloy the grains are elongated along the direction of extrusion with a more or less homogeneous distribution of the alumina particles. The samples deformed in tensile tests at low temperatures (−196° C to + 20° C) reveal a high dislocation density, the dislocations tending to arrange in cell boundaries with increasing strain. Evidence for cross-slip traces in the region between the particles. For low deformations (≤ 1%) at + 20° C, the dislocation density calculated from the activation volume for the dislocation intersection process (forest process) is in agreement with the dislocation density measured by electron microscopy. After deformation at + 350° C the dislocation density is also high, while dislocation loops can be recognized both attached to the particles and isolated. Author

N65-35531# Denver Research Inst., Colo.
RESEARCH ON THE SAMARIUM-TYPE INTERMEDIATE PHASES OF INTRA-RARE-EARTH BINARY SYSTEMS
C. E. Lundin Jun. 1965 38 p refs
(Contract Nonr-3661(02))
(AD-619201)

Four new binary intra-rare earth systems were investigated by metallography, hardness, and density measurements to confirm the presence of the intermediate samarium-type phase. The systems were: La-Lu, Nd-Lu, Sc-Gd, and Sc-La. The lutetium systems exhibited isomorphism with previous binary intra-rare earth systems, whereas the scandium systems did not. Thermal analysis and resistivity techniques were employed to determine the temperature at which the samarium phase forms in representative intra-binary systems. The thermal analysis and resistivity curves did not indicate reproducible thermal arrests or inflections. The thermodynamics of the intrabinary rare earth systems are being studied by liquid metal solution calorimetry. It was found that the solution of light rare earths were relatively easy in tin, whereas the heavy rare earths were very slow. Other liquid metal calorimeter baths are presently being investigated such as bismuth and indium. Indium shows much more promise for the solution of heavy rare earths.
Author

N65-35548# Pratt and Whitney Aircraft, Middletown, Conn.
THE ELECTRICAL RESISTIVITY OF LITHIUM AND COLUMBIUM-1 ZIRCONIUM ALLOY TO 1430C
D. V. Rigney, S. M. Kapelner, and R. E. Cleary Sep. 1965 21 p refs
(Contract AT(30-1)-2789)
(TIM-854)

The electrical resistivities of liquid lithium and columbium-1 zirconium alloy were measured to temperatures of 1430° C and 1446° C respectively. The temperature dependence of the electrical resistivity for each material is given. The thermal conductivity of lithium, calculated by means of the Wiedemann-Franz-Lorenz relation, has a positive temperature coefficient over the temperature range to 1430° C.
Author

N65-35549# Pratt and Whitney Aircraft, Middletown, Conn.
REACTION RATE OF COLUMBIUM-1 ZIRCONIUM ALLOY WITH OXYGEN AT LOW PRESSURES
J. F. Hogan, E. A. Limoncelli, and R. E. Cleary Sep. 1965 21 p refs
(Contract AT(30-1)-2789)
(TIM-901)

The rate of reaction of columbium-1 zirconium alloy with oxygen at 2000F was determined by thermogravimetric methods in an ultra high vacuum system at oxygen pressures in the range of 7.7×10^{-7} to 5.0×10^{-5} torr. The data indicated that the reaction rate was controlled by pressure and was independent of time up to 6 hours. The reaction rate is given by the equation:

$$\log R\ (\text{mg cm}^{-2}\,\text{hr}^{-1}) = 22.188 + 11.867 \log P + 2.174 (\log P)^2 + 0.1414 (\log P)^3;\ (P \text{ in Torr})$$

The oxygen sticking factors calculated from these data are 0.42 and 0.74 at oxygen pressures of 5.0×10^{-5} torr and 7.7×10^{-7} torr, respectively.
Author

N65-35552# Birmingham Univ. (England). Dept. of Physical Metallurgy.
THE NUCLEATION AND DEVELOPMENT OF A RECRYSTALLISED STRUCTURE Final Technical Report, 1 May 1964–30 Apr. 1965
C. A. P. Horton and N. B. W. Thompson [1965] 42 p refs
(Contract DA-91-591-EUC-3284)
(AD-466514)

The experimental program is designed to follow the recrystallization process from the earliest stages onwards. The first material to be studied is zinc, whose behavior is typical of hexagonal metals. Experiments are carried out in which zinc bicrystals of closely controlled orientation can be deformed by a known set of forces, at predetermined strain rates and temperatures. Towards this end, zinc bicrystals of controlled orientation have been produced. Apparatus designed to deform the bicrystals by shearing parallel to their grain boundaries has been built. Techniques for optical and electron microscopy, and X-ray diffraction examination of the structure of the bicrystals have been developed. Examples of thin foil electron-microscopy of zinc, and of the X-ray microbeam reflection microscopy are presented.
Author

N65-35568# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTERNAL FRICTION PEAKS IN THE HIGH CHROMIUM AND HIGH CHROMIUM–NICKEL STEELS AT ELEVATED TEMPERATURES
Ching-ping Kung 27 Jul. 1965 19 p refs Transl. into ENGLISH from Wu Li H'sueh Pao (Peking), v. 17, no. 5, 1961 p 237–245
(FTD-TT-64-1011/1+2+3+4; AD-619312)

In the present investigation several internal friction peaks were observed in four grades of high chromium steels and eight grades of high chromium–nickel steels in the measurement at elevated temperatures by means of a low-frequency torsional pendulum. In three ferritic high chromium steels (27Cr, 25CrTi and 20Cr) quenched from an elevated temperature, an internal friction peak was observed in the vicinity of 570° C. The activation energy associated with this internal friction peak for the specimens of 27Cr and 20Cr was found to be about 87,000 cal/mole. In the specimens of the above-mentioned three high chromium steels, which were furnace-cooled from an elevated temperature, an additional friction peak appeared in the vicinity of 640° C. In the specimens of the 13Cr grade, which were furnace-cooled from an elevated temperature, an internal friction peak was observed in the vicinity of 610° C. In all eight austenitic high chromium–nickel steels an internal friction peak was observed in the neighborhood of 730° C. The activation energy associated with this internal friction peak, determined in the 19Cr 18Ni specimens, was about 85,000 cal/mole.
Author

N65-35575*# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF MECHANICAL PROPERTIES OF CHROMIUM, CHROMIUM-RHENIUM, AND DERIVED ALLOYS Twenty-Second Quarterly Progress Report, Jul. 1–Sep. 30, 1965
A. Gilbert 15 Sep. 1965 15 p refs
(Contract NASw-101)
(NASA-CR-67373) CFSTI: HC $1.00/MF $0.50 CSCL 11F

A feasibility study was made to determine whether a quenching experiment could be used to study the effect of rhenium on vacancy clustering in molybdenum. Quenching specimens were in the form of sheet, and vacancy sinks having random dislocations were used in the experiments. The procedure involved preparation of the sheet samples by cross rolling, annealing in a hydrogen atmosphere, heating in a tantalum-element furnace, annealing at maximum temperature, and quenching in liquid tin. After retrieval from the molten tin, the sheet samples were cleaned in hydrochloric

acid, and thin foils were prepared for transmission microscopy by electrolytic dissolution in alcohol and sulfuric acid. Results indicate that grain sizes produced by the annealing treatment prior to quenching were very fine; many instances of dislocation networks inhomogeneously distributed within the grains appeared; and there was a fairly high density of random dislocations which provided a large number of grain-boundary sinks to which vacancies, in the form of helical dislocations, diffused during the quench. The feasibility of using the quenching procedures was established. G.A.L.

N65-35613# Stanford Univ., Calif.
ELASTIC AND PLASTIC PROPERTIES OF CRYSTALLINE SOLIDS AT ELEVATED TEMPERATURE Interim Technical Report, Oct. 1959–Sep. 1964
Jack L. Lytton, John A. Hren, Kenneth T. Kamber, Alan J. Ardel, Craig R. Barrett et al Wright-Patterson AFB, Ohio. ARL, Jan. 1965 42 p refs
(Contract AF 33(616)-6789)
(ARL-65-3; AD-615561)

An experimental study of structural factors which control high temperature elastic and plastic properties of solids is reported. It is shown that the strength of pure polycrystalline metals at elevated temperature is controlled primarily by the rate of atomic mobility and the elastic modulus. The apparent activation energy for creep was found to be greater than that for self-diffusion. If appropriate corrections are made for the change of elastic modulus with temperature, the activation energy for creep is equal to that for self-diffusion. J.M.D.

N65-35627# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF DIFFUSION OF SILICON AND TITANIUM IN NIOBIUM
P. M. Arzhanyy, R. M. Yolkova, and D. V. Prokoshkin 22 Jan. 1965 10 p refs Transl. into ENGLISH from Tr. Inst. Met. Akad. Nauk SSSR (Moscow), no. 11, 1962 p 78–82
(FTD-TT-64-710/1+2; AD-610798)

Data are presented on the diffusion of silicon and titanium in niobium from the solid phase in a broad range of temperatures and with different contents. Considered were the structures and the makeup of the phases which were formed in the process of the interaction of niobium with the diffusing elements. An investigation was made of the kinetics of the oxidation of niobium saturated by silicon and titanium. The structure and phase makeup of the oxidized film was determined. It was shown that the surface of niobium, when saturated by silicon and titanium at a temperature of 1200°, oxidizes to a lesser extent by a factor of almost one and a half than the surface of niobium saturated by silicon. Also, a thin scale was formed which was tough and well connected with the surface of the niobium. R.W.H.

N65-35663# Little (Arthur D.), Inc., Cambridge, Mass.
FINE METAL FILAMENTS FOR HIGH-TEMPERATURE APPLICATIONS Technical Documentary Report, Mar. 1964–Mar. 1965
Emerson H. Newton, D. E. Johnson, J. L. Sienczyk, and E. Sullivan Wright-Patterson AFB, Ohio. AF Mater. Lab., Apr. 1965 87 p refs
(Contract AF 33(657)-10539)
(AFML-TR-65-124; AD-617255)

A number of single- and multi-metal coatings were applied by electrodeposition to 1-mil tungsten and 3% rhenium-tungsten alloy filaments. These included iron, manganese-chromium, chromium, chromium-nickel, gold-chromium-nickel, silver-cobalt-aluminum, silver-nickel-aluminum, gold-silver-nickel-aluminum, gold-silver-iron-nickel-aluminum, and gold-silver-iron-nickel-chromium. The coated filaments were evaluated for oxidation resistance and high-temperature strength in 2000° F air. A five-layer coating of gold-silver-iron-nickel-aluminum, 0.3 mil total thickness, on a 1-mil rhenium-tungsten alloy filament provided maximum protection, almost 36 minutes, and maintained the highest strength, 119,000 psi, than any other coating investigated. Flat nickel filaments as small as 2 × 0.25 mils were electroformed on and removed from a cylindrical brass mandrel having a 2-mil wide spiral of stainless-steel wire as the plating surface and selectively stopped-off with an epoxy resin. The mandrel was made by winding a 2-mil wire on a brass cylinder, applying the epoxy resin, and sanding it down after the resin had hardened. Author

N65-35678# Martin Co., Baltimore, Md.
ENVIRONMENT-SENSITIVE MECHANICAL BEHAVIOR: STATUS AND PROBLEMS
A. R. C. Westwood Jun. 1965 83 p refs
(Contracts Nonr-4162(00); DA-31-124-AROD-63)
(TR-65-5; AD-617778)

During the past few years, materials scientists have expressed a renewed interest in the study of environment-sensitive mechanical behavior. This interest has resulted in the discovery of new phenomena, the development of some new concepts, the profitable application of knowledge from other areas of study to this area, and the application of recently developed experimental techniques to such well-established phenomena as stress-corrosion cracking and liquid metal embrittlement. This paper describes some of this recent work, and discusses possible mechanisms for the phenomena described. Areas where more work is required are indicated. Author

N65-35712# Naval Ordnance Test Station, China Lake, Calif.
NEUTRON-ACOUSTIC IRRADIATION OF ALUMINUM SINGLE CRYSTALS
B. Langenecker and C. W. Fountain May 1965 11 p refs Repr. from Phil. Mag., v. 11, no. 111, Mar. 1965 p 513–519
(NOTS-TP-3825; NAVWEPS-8753; AD-616806)

Ultrasonic irradiation of ~ 25 w/cm^2 at 20 kc may increase the critical resolved shear stress by a factor of 4 in 99.999% pure aluminum single crystals. This acoustic hardening is accompanied by a yield-point phenomenon, which, in its graphical appearance, resembles effects by neutron irradiation with no sound applied. Hardening by ultrasound and by neutron irradiation are compared, and effects of the superposition of fast neutrons (> 0.1 mev; ~ 2 × 10^{16} n/cm^2) and intense ultrasound (~ 25 w/cm^2 at 20 kc) in aluminum single crystals having diameters between 0.6 and 1.5 mm are presented. Increases were found to amount to as much as a factor of 14 in the critical resolved shear stress of these crystals compared to untreated samples. Simultaneously, the electric resistivity increased with combined treatment by 3.2 times over untreated samples. The results from these investigations are discussed in the light of present theories of neutron and acoustic radiation damage. Author

N65-35749# Solar, San Diego, Calif.
EVALUATION OF RMSRP TUNGSTEN SHEET Final Report, Sep. 1963–Jul. 1965
F. St. Germain 9 Jul. 1965 195 p refs
(Contract NOw-63-0786-d)
(ER-1399-6; AD-617733)

The objectives of this study on tungsten sheet were to determine metallurgical uniformity and mechanical properties; establish formability limits and optimum forming temperatures; fabricate and test structural elements; and fabricate a typical aerospace subassembly component. Tensile property data for several gages of material encompassing the temperature range from ambient to 3000° F are presented. Confidence limits on the elevated temperature mechanical properties for tungsten are also included. Results of the compression test evaluations up to 1800° C for 0.060- and 0.100-inch sheet are also presented in this report. Five joining techniques for tungsten were investigated and of the five, diffusion bonding and mechanical joining showed the most promising. An investigation was conducted to determine the formability characteristics of tungsten sheet in the area of predicting and developing forming limits and establishing optimum forming temperatures for several conventional processes. Structural element bend test panels were fabricated from thin gage tungsten sheet. Author

N65-35751# United Aircraft Corp., East Hartford, Conn. Research Labs.
INVESTIGATION OF FRACTURE MECHANISMS, THERMAL STABILITY, AND HOT-STRENGTH PROPERTIES OF CONTROLLED POLYPHASE ALLOYS Quarterly Progress Report No. 1, 12 Mar.–12 Jun. 1964
J. A. Ford, B. J. Bayles, and F. D. George 12 Jul. 1964 18 p refs
(Contract NOw-64-0433-d)
(C-910239-1; AD-609103)

The results of preliminary investigations of the effect of phase particle size on tensile strength behavior, thermal stability, and hot-strength of Al–$CuAl_2$ and Al–Al_3Ni eutectics are detailed. Considerable difficulties have been encountered in producing good band- and colony-free ingots of the Al–$CuAl_2$ eutectic at high solidification rates. Several experimental variations in the controlled solidification process are being utilized in order to overcome these difficulties. The pre-heat treat studies of the metallographic and crystallographic characteristics of an Al–$CuAl_2$ ingot (solidification rate of 2.2 cm/hr) have been essentially completed. This ingot shows remarkable constancy in these respects. Similarly the pre-heat treat studies of Al–Al_3Ni specimens have been initiated and are progressing well. One specimen of this alloy has been heat treated at 600° C for 216 hours and has shown a 50 fold decrease in Al_3Ni rod density and a change in rod shape from elliptical to irregular hexagonal cross section. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-34770 Joint Publications Research Service, Washington, D. C.
A NEW TYPE OF RIGID POLYVINYL CHLORIDE HAVING HIGH IMPACT STRENGTH
Han-Min Tseng and Yun-Kung Feng *In its* Transl. on Communist China's Sci. and Technol., No. 214 7 Sep. 1965 p 22–26 refs (See N65-34767 23-06) CFSTI: $2.00

The properties of a high heat resistant and high impact strength polyvinyl chloride (NASC) were studied, along with industrial conditions for its preparation. The mechanical–chemical reactions between polyvinyl chloride (PVC) and a copolymer obtained by grafting natural rubber with styrene–acrylonitrile (NAS) were also studied. It was found that use of NAS increased the heat resistance of polyvinyl chloride resin, and lowered the flow temperature making it easier to process and fabricate. Depending on the formulation and blending conditions, experiments showed that NASC has a breaking strength of 425 to 720 kg/cm^2; an impact strength of 334 kg-cm/cm^2; a heat resistance of 5° to 15° C higher than synthetic rubber–PVC; and improved electrical properties. Results also indicate that the glass temperature is raised by 10° to 20° C; it has small water absorption, and improved chemical and dimensional stability. M.G.J.

N65-34807 Geophysics Corp. of America, Anoka, Minn. Viron Div.
POLYETHYLENE FILM WITH A HI-SLIP ADDITIVE AS A BALLOON BARRIER MATERIAL
J. A. Haueter *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 41–46 (See N65-34804 23-20)

One of the factors blamed for polyethylene-balloon ascent failures is blocking between layers of film as the balloons expand and unfold during ascent. This blocking could prevent the balloon from unfolding and cause an internal buildup of superpressure until the balloon ruptures. The use of a slip additive in polyethylene film to decrease the film coefficient of friction was studied as one of the solutions to this blocking problem. Polyethylene suppliers have long used additives in their commercial film. A program was designed to test the use of a hi-slip additive in the balloon-grade polyethylene for use as a balloon barrier material. The film was tested and used to construct three 2.94-million-cubic-foot balloons. This report describes the characteristics of the film, summarizes test results and production problems involved, and presents the limited flight history of balloons flown. M.R.W.

N65-34808 National Center for Atmospheric Research, Boulder, Colo.
STATISTICAL IMPLICATIONS OF BALLOON MATERIALS
R. L. Hauser *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 47–53 (See N65-34804 23-20)

The author has been working the last two years with the scientific balloon group of the National Center for Atmospheric Research. Our concern in the NCAR work has been directed toward improvement of balloon materials for better flight reliability. In this program we have tested a large number of candidate materials—films and scrims—and have been concerned with both character and quality. The quality of polyethylene balloon film is the basis for this paper, since we must recognize that variation of quality is an unavoidable reality in all materials. The strength properties of balloon films will vary from sample to sample in a manner that might be either the normal or the Poisson distribution. These are the most probable distributions, but others are certainly very possible. Author

N65-34809 Litton Systems, Inc., St. Paul, Minn.
BEHAVIOR OF POLYETHYLENE IN SIMULATED BALLOON ENVIRONMENT

W. B. Parsons *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 55–71 (See N65-34804 23-20)
(Contract AF 09(628)-2944)

In our research to evaluate potential balloon materials, we have conducted a survey of available plastic films to find those most promising for balloon manufacture. These will be compared with polyethylene and Mylar—the most predominant materials in balloons at present. There is no assurance, of course, that either will be replaced as the materials of choice; consequently, some of our studies are designed to permit a broader understanding of the characteristics of polyethylene and Mylar. This paper is limited to our initial studies of polyethylene—with particular emphasis on influence of temperature, high-frequency stressing, comparison of lubricants, and cold brittleness. We shall describe some of the equipment that we have developed for these and future studies. While some results are available for presentation here, we are not as yet in a position to draw conclusions as to where these data may lead in relation to balloon performance or to the design of better balloons.
Author

N65-34811 Winzen Research, Inc., Minneapolis, Minn.
A NEW POLYOLEFIN-FILM BALLOON MATERIAL
Donald R. Williams *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 81–84 (See N65-34804 23-20

Because of a high failure rate in standard polyethylene stratospheric research balloons, primarily due to encountering a cold tropopause temperature, a new polyolefin film material called StratoFilm was developed. Its properties surpass all military specifications by substantial margins. Its most significant improvement is in passing cold brittleness tests as low as −84° C, which is lower than most commonly encountered tropical tropopause temperatures. More exacting industrial specifications are used in its production and these are discussed and compared with military specifications. Only a limited number of flights have been made with balloons of StratoFilm but none have failed. It is expected that StratoFilm will increase balloon reliability, and permit heavier loads and higher altitudes at a comparatively low cost.
R.N.A.

N65-34815 Goodyear Aerospace Corp., Akron, Ohio.
A NEW MATERIAL CAPABILITY FOR THE BALLOON FIELD
R. S. Ross *In* AFCRL Proc. 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 123–134 (See N65-34804 23-20)

It is quite readily recognized and understood that in the development field, each new advance in hardware is closely related to the material from which the component is fabricated. As improvements in materials are found, even further advances in performance are possible. This has been particularly true in the balloon field where material improvements have resulted in new gas tightness for longer endurance flights and lighter weight for higher altitude capabilities. The material development to be discussed here consists of a means of obtaining balloon components in predetermined shapes so as to permit relative movement between the balloon and the surrounding air. The performance improvement could, therefore, be in stability, drag reduction or increased lift. The specific application will determine how this material can best be used and the amount of improvement in performance that can be expected. Manufacturing machinery and fabricating techniques are now being evaluated that will permit greater rate of climb for free balloons and increased lift stability for tethered balloons, which could result in altitude capabilities above those possible by static lift alone.
Author

N65-34870# Wyandotte Chemicals Corp., Mich.
SYNTHESIS OF LOW TEMPERATURE OIL RESISTANT URETHANE ELASTOMERS Final Report, 1 Jul.–31 Dec. 1963, 15 May 1964–15 May 1965
[1965] 42 p ref
(Contract DA-20-018-ORD-24883)
(AD-619376)

The preparation of polyether urethane elastomers is described, and the effect of variation in polyether backbone, formulation and processing on their properties evaluated. Special attention was given to attaining elastomers with low temperature flexibility at −55° C. combined with <10% ASTM No. 3 oil absorption when immersed 70 hours at 100° C. By using high molecular weight polyether polyols prepared from approximately equal molar quantities of ethylene oxide and tetrahydrofuran, these two target properties were achieved with only a slight compromise in tensile strength requirements. The key factor in the preparation of elastomers with good oil resistance was the concentration of the polar linkages and crosslinks between long, flexible polyether chains. The low temperature flexibility was attained by using the ethylene glycol-tetrahydrofuran polyols to provide the long, flexible polyether chains. Cast urethane–urea elastomers have been prepared from blends of high molecular weight polyethers and polytetramethylene ether glycols which meet the mechanical strength, compression set at 100° C. and low temperature flexibility at −55° C. requirements of the contract. However, the oil resistance requirement was not satisfied.
Author

N65-35071*# Melpar, Inc., Falls Church, Va.
DEVELOPMENT OF IMPROVED POLYMERIC MATERIALS FOR CRYOGENIC PROPELLANT TANK LINERS AND POSITIVE EXPULSION BLADDERS Final Report, 1 May 1964–30 Apr. 1965
H. E. Podall, Z. Oser, L. K. Eliason, and J. M. Augl Jun. 1965 176 p refs
(Contract NAS3-4183)
(NASA-CR-54433) CFSTI: HC $5.00/MF $1.00 CSCL 11I

The influence of biaxial orientation parameters on the folding endurance (twist-flex life), tensile properties, thermal expansion coefficient and permeability of poly(ethylene terephthalate) (PET) films at ambient temperature and at liquid nitrogen temperature (−196° C) was studied. Sequential and simultaneous biaxial orientation procedures was evaluated in regard to their effect on the properties of PET films. The twist-flex life and tensile properties of various commercial films such as Mylar types A, C, and T, Lexan, Vitel types VMF-414 and VFR-338, Kapton (H-film) and Kodar were determined at ambient temperature and at liquid nitrogen temperature. The twist-flex method of determining the relative flexibilities of polymeric films for use in cryogenic positive expulsion bladders was studied and the important parameters affecting the results of this test were defined. The utility of broad-line nuclear magnetic resonance as a diagnostic screening tool for assessing the potential flexibility of polymers for cryogenic applications was determined. Non-commercially available polymers were synthesized, and their conversion into thin biaxially oriented films was studied.
Author

N65-35122*# IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF SPACE-STABLE THERMAL-CONTROL COATINGS (PAINTS WITH LOW SOLAR ABSORPTANCE/EMITTANCE RATIOS) Triannual Report, 20 Jun.–20 Oct. 1964

G. A. Zerlaut, J. E. Gilligan, and Y. Harada 21 Dec. 1964 72 p refs
(Contract NAS8-5379)
(NASA-CR-67295; IITRI-C6014-18) CFSTI: HC $3.00/MF $0.75 CSCL 11C

The development of stable thermal control coatings with low solar absorptance emittance ratios is described. Microporous coating investigations, inorganic pigment and binder studies, and methyl silicone synthesis and silicone photolysis experiments are discussed. Experiments on the effects of space simulation on the foaming of LTV-602 are discussed. The effects were severe and are thought to involve the random deep scattering of ultraviolet and contamination from residual Porofor N blowing agent. The inorganic studies indicate that zinc titanate–potassium silicate paints are stable to ultraviolet radiation in vacuum. A solar absorptance of 0.12 was achieved with a zinc titanate paint. Severe damage was exhibited by barium sulfate, zirconia, dyprosium oxide, lithium aluminum silicate, and zirconium–spinel when irradiated as powders for only 230 equivalent sun hours. Heat and chemical treatment improved resistance to ultraviolet in vacuum. Exceptions were magnesium aluminate–spinel and zinc titanate coatings. Pertinent literature on silicone photolysis is discussed. An apparatus constructed for photolysis experiments is described. R.N.A.

N65-35143# Dow Chemical Co., Denver, Colo.
MARASET EPOXY RESIN AND COORS PELLETIZED ALUMINA AS A METALLOGRAPHIC SPECIMEN POTTING COMPOUND
A. E. Calabra [1965] 11 p refs
(Contract AT(29-1)-1106)
(RFP-545; Conf-650414-2)

A potting technique which utilizes a mixture of Coors pelletized alumina (Al_2O_3) and Maraset epoxy resin is reported. This technique was adapted to virtually all materials where edge retention and specimen flatness is metallographically required. The addition of Coors pelletized alumina of various hardness and mesh sizes to Maraset epoxy resin provides the laboratory with a potting compound which was customized to the metallographic specimen. Excellent sample flatness and edge retention were obtained on very soft to very hard materials. The Maraset epoxy resin–Coors pelletized alumina specimen potting compound has minimal hold shrinkage, and the epoxy resin–alumina mixture cures at a low temperature of approximately 65° C. R.W.H.

N65-35201*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN ANALYTICAL METHOD FOR EVALUATING THE EFFECTS OF RADIATION IN VACUUM ON THE MECHANICAL PROPERTIES OF RIGID PLASTICS
Jerome J. Lohr and John A. Parker [1963] 6 p refs
(NASA-TM-X-54020) CFSTI: HC $1.00/MF $0.50 CSCL 11I

The combined effects of ultraviolet radiation and vacuum on the mechanical properties of a typical rigid plastic have been investigated as a function of strain rate, tensile test temperature and irradiation dose. It has been shown that the yield stress can be expressed as a simple function of strain rate and test temperature for nonirradiated polymethyl methacrylate. For this polymer, whose primary degradation process under irradiation consists of scissioning with consequent production of monomer at the irradiation temperature, it is also possible to predict the yield stress in terms of the radiation dose. This has been accomplished by including a term describing the plasticizing effect of the residual monomer in the yield stress expression. Author

N65-35203*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEGRADATION OF POLYMERIC COMPOSITIONS IN VACUUM TO 10^{-9} mm Hg IN EVAPORATION AND SLIDING FRICTION EXPERIMENTS
Donald H. Buckley and Robert L. Johnson [1964] 30 p refs Presented at the 20th Ann. Tech. Conf., Soc. of Plastics Engr., Atlantic City, 28–31 Jan. 1964
(NASA-TM-X-54549) CFSTI: HC $2.00/MF $0.50 CSCL 11I

Solid compositions studied included PTFE, PCFE, polyimides, both filled and unfilled, and fluorocarbon telomers. Evaporation experiments were conducted at ambient temperatures to 1100° F and pressures to 10^{-8} mm Hg. Various molecular weights of different polymers were examined. Results indicate that evaporation rates in vacuum for polymers vary with molecular weight. Friction and wear experiments were conducted with a 3/16-inch-radius rider hemisphere (usually polymer) sliding on a flat disk (various materials) at speeds to 1480 feet per minute with a 1000-gram load on the rider specimen and at an ambient pressure of 10^{-9} mm Hg. Fillers were found to influence markedly the wear of PTFE and PCFE in vacuum as a result of changes in heat dissipation properties, but they showed little or no influence on friction. Unfilled polyimide was found superior to unfilled PTFE and PCFE in friction, in wear, and in degradation characteristics. With the aid of a mass spectrometer, the decomposition mechanism for various PTFE compositions was observed during sliding. Author

N65-35315*# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
DEVELOPMENT OF DIELECTRIC WINDOWS FOR SPACECRAFT ANTENNAS Third Quarterly Report, 1 Jan.–31 Mar. 1964
B. G. Kimmel [1964] 17 p
(Contract NAS8-11026)
(NASA-CR-58003; P64-52) CFSTI: HC $1.00/MF $0.50 CSCL 11I

Screening tests of a number of reinforced plastics have been completed with the exception of the determination of the effect of ultraviolet irradiation on the dielectric properties. Dielectric measurements conducted with the resonant cavity dielectrometer in a vacuum chamber demonstrated the practicality of making high vacuum dielectric measurements. At the same time, difficulties experienced in the vacuum stabilization of reinforced plastics dielectric specimens showed the necessity for equipment especially designed to perform high vacuum dielectric measurements. Author

N65-35322# Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
WEAPON SYSTEM 133A: PROGRAM PROGRESS RESEARCH AND DEVELOPMENT STAGE I MINUTEMAN MOTORS Contract Status Report, 1 Jan.–31 Mar. 1965
[1965] 50 p
(Contracts AF 04(694)-271; AF 33(600)-36514)
(AD-464967)

Among some of the data presented for Stage I Minutemen Motors are: aft closure removal, operation longlife motors, wing nozzle verification, ordnance development, flight test program, weapon system safety, and nuclear hardness study. R.W.H.

N65-35361*# Lockheed-Georgia, Marietta. Georgia Nuclear Labs.
POLYMERIC MATERIALS IRRADIATION, DATA SUBMITTAL

May 1965 58 p
(Contract NAS8-5332)
(NASA-CR-67342; ER-7887) CFSTI: HC $3.00/MF $0.50 CSCL 11I

Tabulated data are presented on physical and electrical tests performed on polymeric materials after exposure to nuclear radiation in a vacuum environment. The tests measured dielectric constant, dissipation factor, volume resistivity, dielectric strength, compression strength, tensile strength, and hardness. The radiation environment and post-irradiation test procedures are described. R.N.A.

N65-35407*# University of Southern Calif., Los Angeles. Dept. of Chemistry.
LOW TEMPERATURE THERMAL EXPANSIVITIES OF POLYETHYLENE, POLYPROPYLENE AND THEIR MIXTURES
Jacques L. Zakin (Missouri Univ.) and Robert Simha [1964] 44 p refs
(Grant NsG-343)
(NASA-CR-67329) CFSTI: HC $2.00/MF $0.50 CSCL 11I

To determine if transitions other than the main glass transition temperature exist, low temperature measurements were made of the length-temperature curves for polyethylene and polypropylene, their mixtures and copolymers. Presented are results of studies of multiple transitions in single component systems, and the effect of physical mixtures of polyethylene and polypropylene on glassy transitions. Included is a discussion of experimental materials and procedures, and techniques used in data analysis. S.C.W.

N65-35468# Societa Richerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
RECOVERY OF THE ELECTRICAL RESISTIVITY IN VARIOUS TYPES OF PYROLYTIC CARBON AFTER NEUTRON IRRADIATION AT −196°C
M. Domenici, U. Perito, F. Pieragostini, and H. Walther 1965 22 p refs Presented at the 2d Conf. on Industrial Carbon and Graphite, London, Apr. 1965
(SORIN-56) CFSTI: HC $1.00/MF $0.50

The annealing of pyrolytic carbon following neutron irradiation at liquid nitrogen temperature is described by means of two series of considerations. The first concerns the definition of suitable intervals of temperature identifying each individual process, as well as the relative limits of this picture regarding the influence of the structure of the samples and/or the dose received. The second concerns the description of the mechanism, the nature of point defects, and the related activation energies governing the recovery in any single stage. The comprehensive picture described is in agreement with the theoretical considerations of Iwata and Suzuki, concerning the development of a series of successive processes during the annealing from very low temperature. But the activation energies experimentally deduced in this work tend to shift towards higher temperatures with the occurrence of the single successive processes. R.N.A.

N65-35510# Societa Richerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
NEUTRON DIFFRACTION RESEARCH ON THE BINARY SYSTEM SODIUM-SILICATE GLASS
G. Carraro (Centro Studi Vetro, Venice) and M. Domenici 1965 22 p refs Presented at the 7th Intern. Congr. on Glass, Brussels, 28 Jun.–3 Jul. 1965
(SORIN-61) CFSTI: HC $1.00/MF $0.50

Earlier examinations of vitreous silica by neutron diffraction have been extended to the binary system sodium-silicate glass. Typical spectra as obtained from a series of samples prepared in the range of molecular composition between 5 to 1 and 1.1 to 1 SiO_2 to Na_2O are reported. The diffraction patterns have been extended in some instances up to values of $S = 4\pi(\sin\Theta)/\lambda = 18\text{Å}^{-1}$ utilizing two different wavelengths: $\lambda = 1.046$ and 0.523 Å. The influence of different thermal annealing during the sample preparation has been checked by comparing the related spectra. Interpretation has been attempted on the basis of the differential method applied to the inverse Fourier transforms of the direct diffraction patterns, in order to identify coordination numbers corresponding to the positions of the Na-ions. The existence of paracrystalline domains of sodium meta- and di-silicate is also discussed. Author

N65-35572# Alabama Univ., University. Rohm and Haas Co., Huntsville, Ala. Bureau of Engineering Research.
MATHEMATICAL STUDIES OF COMPOSITE MATERIALS, II, SEPTEMBER 1, 1963–MAY 31, 1964
Howard B. Wilson, Jr., James L. Hill, and James G. Goree 1 Jun. 1965 184 p refs Prepared for Rohm and Haas Co.
(Contract DA-01-021-ORD-11878(Z))
(S-50; AD-468569)

Solutions are presented for several linear elastostatic boundary value problems pertaining to infinite bodies which contain holes or inclusions. The first two sections of the report consider planes which are loaded by normal stresses at infinity and contain a single perfectly smooth inclusion of circular or elliptic form. The third section is devoted to determination of stresses in an infinite plate having a doubly periodic rectangular array of holes which are either uniformly pressurized or contain rigid inclusions bonded to the plate. The principal stresses at infinity act in the directions of the rectangular grid and the holes are assumed to have symmetry axes in these directions. The final section of the report presents a solution for the axisymmetric stress field about two rigid spherical inclusions bonded to a surrounding infinite medium. The inclusions can be unequal in size and are arbitrarily spaced with two independent normal stress components specified at infinity. Numerical results were obtained for each problem studied. Programs written in FORTRAN II programming language are listed in appendices. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-34726 Joint Publications Research Service, Washington, D. C.
ON SOME CLASSES OF COMPLEX SYSTEMS. III
I. N. Kovalenko *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 1–13 refs (See N65-34725 23-34) CFSTI: $6.00

General analytical procedures are presented for the investigation of random processes related to the functioning of piecewise-linear complex system. An imbedded Markov chain is related to the process of operation of the system; its general properties are investigated. The class of distributions is indicated to which the distribution of the investigated process belong. An ergodic theorem is proved. Author

N65-34727 Joint Publications Research Service, Washington, D. C.
SERVICING OF AN IRREGULAR INPUT FLOW IN PROBLEMS WITH AN UNLIMITED NUMBER OF UNITS
L. M. Abol'nikov *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 14–19 refs (See N65-34725 23-34) CFSTI: $6.00

The problem of servicing an irregular flow of demands arriving in a system with an infinite number of units is investigated. The probability of arrival of a group (of requirements) of s demands is equal to a (s = 1, 2, 3 ...). The flow of demands is assumed to be simplest with an intensity λ, and the servicing is exponential with the parameter μ. For a stationary case the problem is solved by the method of generating functions. In conclusion an example of group arrival of demands with m demands in each group is investigated. Author

N65-34728 Joint Publications Research Service, Washington, D. C.
THE REGULAR METHOD FOR RESOLUTIONS OF GAMES WITH PIECEWISE-CONSTANT PAYOFF FUNCTIONS
B. S. Fleischman and V. P. Krapivin *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 20–29 refs (See N65-34725 23-34) CFSTI: $6.00

A regular method is proposed for resolution of a game with a piecewise-constant payoff function. Optimal mixed strategies are found for special classes of stepwise payoff functions. The limiting case is investigated. Statements of some problems in connection with resolution of multistep games with noise are presented. Author

N65-34729 Joint Publications Research Service, Washington, D. C.
APPLICATION OF THE THEORY OF STATISTICAL SOLUTIONS TO THE PROBLEM OF EXTRAPOLATION
V. S. Gubenko *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 30–42 refs (See N65-34725 23-34) CFSTI: $6.00

The problem of extrapolation is formulated in terms of the theory of statistical solution. This gives the possibility of obtaining for an arbitrary criterion of optimalness in the presence of samples of any size a general solution of the problem of extrapolation even in those cases where the parameters of distribution are unknown and even the distribution itself is unknown. A number of examples are investigated part of which may be of independent practical interest. Author

N65-34730 Joint Publications Research Service, Washington, D. C.
ON OILWELL CONTROL THEORY
M. V. Meyerov and V. G. Fridman *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 43–54 refs (See N65-34725 23-34) CFSTI: $6.00

The dynamics of optimal control of oilwells are investigated. The problem is formulated as a problem of linear programing in a functional Gilbert space. Considering the specific properties of the problem, it is possible to construct a general solution in the form of a series of smooth solutions. The structure of each smooth solution is determined by a procedure which is analogous to the simplex method—junction points of smooth solutions—on a grid model of a stratum [bed]. Author

N65-34731 Joint Publications Research Service, Washington, D. C.
ON CONSTRUCTION OF ADDITIONAL RESTRICTIONS FOR SOLUTION OF PROBLEMS OF INTEGRAL LINEAR PROGRAMMING
Yu. Yu. Finkel'stein *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 55–57 refs (See N65-34725 23-34) CFSTI: $6.00

A procedure is proposed for forming additional stronger limitations in solving problems of integral linear programing in which all variables are required to be integral. R.N.A.

N65-34732 Joint Publications Research Service, Washington, D. C.
SOME PSYCHOLOGICAL EXPERIMENTS RELATED TO THE SOLUTION OF THE PROBLEM OF SHORTEST COMBINATION OF POINTS IN A PLANE
I. B. Motskus *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 58–64 refs (See N65-34725 23-34) CFSTI: $6.00

The problem of numerical evaluation of heuristic possibilities of man is presented for solution of multiextremal problems. The problem stated is studied in an example which is convenient for investigation of the problem of shortest combination of points in a plane. Basic peculiarities of the investigation procedure are pointed out. Some of the dependencies obtained of errors in the heuristic solution on different factors are presented. Author

N65-34739 Joint Publications Research Service, Washington, D. C.
USING THE STATISTICAL TEST METHOD FOR DETERMINATION OF THE DISTRIBUTION FUNCTION FOR COMPLETION TIME IN POWERLINE PLANNING
I. Ye. Mayzlin and L. P. Nikolayeva *In its* News of the Acad. of Sci. USSR, Dept. of Tech. Sci., Tech. Cybernetics, No. 3, 1965 14 Sep. 1965 p 134–143 refs (See N65-34725 23-34) CFSTI: $6.00

The basic probability characteristics of a model of a PERT type system—the distribution function for time of executing the entire development—are determined. A description of the algorithm and a detailed block diagram are presented. Author

N65-34858# Princeton Univ., N. J. Inst. for Advanced Study.
STUDIES IN ANALYSIS, NUMBER THEORY AND LOGIC Final Report, 1 Jul. 1963–30 Jun. 1965
Felix E. Browder, Clifford J. Earle, Erik Ellentuck, Tomio Kubota, Howard L. Resnikoff et al 30 Jun. 1965 3 p
(Grant DA-ARO(D)-31-124-G455)
(AROD-3951-25, AD-619307)

Titles are listed for manuscripts related to research in mathematical analysis, number theory, and logic. Both published manuscripts and those in process of preparation are included. M.W.R.

N65-34877# Stanford Univ., Calif. Computer Science Dept.
MATRIX THEOREMS FOR PARTIAL DIFFERENTIAL AND DIFFERENCE EQUATIONS
John Miller and Gilbert Strang 16 Jul. 1965 34 p refs
(Contract Nonr-225(37))
(CS28; AD-618217)

We extend the work of Kreiss and Morton to prove: for some constant K(m), where m is the order of the matrix A, $|A^n v| \leq C(v)$ for all $n \geq 0$ and $|v| = 1$ implies that $|SAS^{-1}|$

$\leq$ I for some S with $|S^{-1}| \leq 1$. $|Sv| \leq K(m)C(v)$. We establish the analogue for exponentials e^{Pt}, and use it to construct the minimal Hilbert norm dominating L_2 in which a given partial differential equation with constant coefficients is well-posed. Author

N65-34902*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TEST OF HYPOTHESES AND ESTIMATION OF THE CORRELATION COEFFICIENT USING QUANTILES, II
Isidore Eisenberger 15 Sep. 1965 37 p refs
(Contract NAS7-100)
(NASA-CR-67186; JPL-TR-32-755) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Results are presented of the investigation into the use of quantiles in data compression of space telemetry. Tests of hypotheses are given using one, two, and four optimum sample quantiles. In Test A, one decides whether the mean of a normal population has a value of μ_1 or a value of μ_2 when the variance is unknown. Test D decides whether the unknown means of two normal populations are identical when the common variance is unknown. Test E decides whether the unknown variances of two normal populations are identical when the common mean and variance are unknown. Test F decides whether or not two normal populations are independent when their common mean and variance are unknown. In addition, estimators of the correlation coefficient are constructed. Sub-optimum test statistics and estimators using the same four quantiles are also given. In all cases, the sample sizes are assumed to be large. Author

N65-34924# Rutgers Univ., New Brunswick, N. J. Statistics Center.
A GENERAL FAMILY OF CHAIN SAMPLING INSPECTION PLANS
Harold F. Dodge and Kenneth S. Stephens 30 Dec. 1964 38 p refs
(Contract Nonr-404(18))
(N-20; AD-610041)

This report proposes a general family of chain sampling inspection plans based on certain concepts incorporated in the "chain sampling inspection plans." A basic feature is the utilization of cumulative results for decision making, intended primarily for use when samples are small. Giving special attention to what is referred to as a general family of "two stage" chain sampling plans for use in lot-by-lot inspections, the report develops the theory for and evaluates the statistical properties of that particular set of such plans that is characterized by acceptance numbers (cumulative results criteria, CRC) of $C_1 = 0$ and $C_2 = 1$. The cumulation of results is restarted after each lot rejection, proceeds in two steps, but extends to and continues with a maximum of only k_2 samples. Tabulated values (and some charts) are given for the OC curves for a collection of plans in which: the size of sample from each lot, n, is 3,5,8,10,15, and 20; and the maximum number of samples for cumulation, k_2, varies from 2 to 10. Author

N65-34992# California Univ., Berkeley. Operations Research Center.
MARKOV-RENEWAL MODELS IN TRAFFIC FLOW THEORY
W. S. Jewell Aug. 1965 14 p refs
(Contract DA-31-124-ARO-D-331)
(ORC-65-24; AD-471568)

This paper explores the extensions to traffic flow models when the traffic stream is assumed to be a Markov renewal process. The primary advantages of this new model are that the types of different vehicles, and the correlation between successive headways arises in a natural way, and the model appears to have side applicability to different traffic phenomena. Some preliminary experimental results are presented here. Author

N65-35039# Naval Ordnance Test Station, China Lake, Calif.
NOTES ON SIMPLEX MODELS IN THE STUDY OF MULTICOMPONENT MIXTURES
J. M. Bownds, I. S. Kurotori, and D. R. Cruise Jan. 1965 41 p refs
(NAVWEPS-8670; NOTS-TP-3719; AD-619651)

The theory is developed from basic analytical geometry and presents a systematic approach to the study of binary and ternary mixtures. Topics include: definition of the simplex, simplex coordinate systems, properties and applications of the coordinate systems, simplex to simplex, and simplex to Cartesian coordinate transformations; linear and nonlinear simplex models for the study of binary and ternary mixtures, the contour problem solved in terms of the nonlinear models, a program to plot the desired contours of ternary systems, statistical studies involving nonlinear models, and relation of simplex models to the thermodynamic properties of multicomponent mixtures. Author

N65-35076# Rocketdyne, Canoga Park, Calif.
THE SPECTRAL CHARACTERIZATION AND COMPARISON OF NONSTATIONARY PROCESSES
M. R. Dubman 2 Aug. 1965 83 p refs
(Contract Nonr-4557(00))
(RR-65-27; AD-619178)

The spectral representation theories of second order stationary, harmonizable, exponentially convex, and normal-type stochastic processes are reviewed and the processes are compared. Locally stationary and asymptotically stationary processes are viewed within the framework of harmonizable and normal-type processes. The concept of a time-dependent spectrum is developed, a general condition for its existence is given, and the time-dependent spectra of harmonizable and normal-type processes are derived. Author

N65-35145# Carnegie Inst. of Tech., Pittsburgh, Pa. Graduate School of Industrial Administration.
NEW ALGORITHMS AND CUTTING PLANE CONSTRAINTS FOR THE SOLUTION OF DIOPHANTINE LINEAR PROGRAMS
Fred Glover (Ph.D. Thesis) Feb. 1965 182 p refs
(Contract Nonr-760(24))
(RR-36; AD-618690)

This thesis presents two computational algorithms for solving the integer linear programing problem and a class of cutting plane constraints that may be employed as part of an algorithmic solution strategy. The first algorithm, called the bound escalation method, is closely related to the all-integer algorithm. The principal point of contrast lies in the concept of the bounding form, which the method is designed specifically to create and then exploit. The second algorithm, called the multiphase-dual method, a more specialized method designed to solve the 0–1 linear programing problem. This method, which is combinatorial in nature, patterns after the additive algorithm, and employs an array of tests applied in conjunction with a surrogate constraint to eliminate large portions of the solution space from consideration. The cutting plane constraints, finally, are generated from a general equation in two parameters. Theorems are proved which specify values for these parameters that yield cuts having certain properties not found in the other cuts in the literature. Author

N65-35182# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
CHARACTERIZATION OF GEOMETRIC AND EXPONENTIAL DISTRIBUTIONS
Gordon B. Crawford Aug. 1965 14 p refs *Its* Mathematical Note No. 421
(DI-82-0461)

Considered are the following properties of two independent random variables X and Y:

$$W = \min (X,Y) \text{ independent of } X - Y.$$

The unsettled problem that arises if X or Y has a singular part is resolved by assuming that W is independent of $|X - Y|$. Distribution functions are used to find the condition where X and Y are discrete, and the random variables b(X-a) and b(Y-a) are geometric. G.G.

N65-35298# Northwestern Univ., Evanston, Ill. Systems Lab.
OPTIMUM DISTRIBUTION OF SWITCHING CENTERS IN A COMMUNICATION NETWORK AND SOME RELATED PROBLEMS
S. L. Hakimi [1964] 20 p refs
(Grant AF-AFOSR-98-63)
(AROD-3298-18; AD-468747)

The concept of a median in a weighted graph is generalized to a multimedian. It is shown that the optimum distribution of p switching centers in a communication network is at a p-median of the corresponding weighted graph. Also considered is the related problem of policing a highway network. S.C.W.

N65-35434# Boeing Scientific Research Labs., Seattle, Wash.
MINIMIZING CONVEX FUNCTIONS OVER A SIMPLEX
Sam C. Saunders and Gordon B. Crawford Apr. 1965 17 p refs *Its* Math. Note No. 404
(DI-82-0428)

We present an iteration procedure to locate the minimum of a continuously differentiable strictly convex function over the unbounded simplex in Euclidean n-space, and we prove that the procedure converges to the unique minimum. This procedure is constructed to facilitate its adaptation to machine programming. Applications of this procedure to maximum likelihood estimation in certain non-parametric cases are mentioned. Author

N65-35453# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
REGULARITY OF SOLUTIONS OF DIFFERENTIAL ELLIPTIC EQUATIONS [REGULARITE DES SOLUTIONS DES EQUATIONS DIFFERENTIELLES ELLIPTIQUES]
Leopoldo Nachbin 1964 20 p refs In FRENCH *Its* Notas de Fisica, Vol. XI, No. 9 CFSTI: HC $1.00/MF $0.50

In a study of the regularity problems associated with the solutions to elliptic partial differential equations, the de Giorgi-Nash theorem, the Harnack-Moser inequality, and the lemma of John-Nirenberg are discussed. Transl. by J.M.D.

N65-35533# Illinois Univ., Urbana.
REAL ZEROS OF THE DEDEKIND ZETA FUNCTION OF AN IMAGINARY QUADRATIC FIELD
Marc Edmon Low 1965 53 p refs
(Contract Nonr-1834(18))
(TR15; AD-618908)

It is known that the Dedekind zeta function of an imaginary quadratic field can be expressed as the product of the Riemann zeta function and a real Dirichlet L-series and also as a sum of Epstein zeta functions. The purpose of this paper is to show that the Dedekind zeta functions of imaginary quadratic fields with discriminants $-d$ such that $1 < d < 593{,}000$, $d \neq 115{,}147$ have no zeros on the positive real axis. This is done by working with approximations to the Epstein zeta functions to show that the associated Dirichlet L-series is positive on the positive real axis. Author

N65-35594# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON SOME MULTIPLE DECISION (SELECTION AND RANKING RULES
Shanti S. Gupta Aug 1964 37 p refs *Its* Mimeograph Ser. No. 21
(Contracts AF 33(657)-11737; Nonr-1100(26))
(AD-607097) CFSTI: $2.00

This paper deals with some multiple decision (ranking and selection) problems. Some relevant distribution theory is given and the associated confidence bounds are derived for the differences (ratios) between the parameters. The selection procedures select a non-empty, small, best subset such that the probability is at least equal to a specified value P that the best population is selected in the subset. General results are given both for the unknown location and scale parameters of the k populations. Some desirable properties of these procedures are studied and proved. Selection of a subset to contain all populations better than a standard is also discussed. Performance characteristics of some procedures for the normal means problem are studied and tables are given for the probabilities of selecting the i^{th} ranked population and for the expected proportion and the expected average rank in the selected subset. A brief review of work by other authors in the problems of selection and ranking and in other related problems is given. Author

N65-35609# Air Force Cambridge Research Labs., Bedford, Mass.
FEASIBLE CONTROL COMPUTATIONS USING DYNAMIC PROGRAMMING
Stephan J. Kahne Apr. 1965 22 p refs *Its* Physical and Mathematical Sciences Res. Papers No. 94
(AFCRL-65-232; AD-615110)

The application of Bellman's dynamic programming technique to realistic control problems has generally been precluded by excessive storage requirements inherent in the method. In this paper, the notion of state mobility is described and shown to be valuable in reducing certain classes of dynamic programming calculations to manageable size. The scheme requires one simple calculation at each stage of the process. In many cases even this calculation may be omitted. It results in the reduction of the range of allowable "state" variables to be scanned. The amount of reduction varies from problem to problem. A simple example exhibits a fifty percent reduction. This corresponds to a fifty percent reduction in storage requirements for the problem. Reductions of one or two orders of magnitude appear possible for certain classes of problems. Author

N65-35620# Martin Co., Denver, Colo.
ON PRODUCTS AND QUOTIENTS OF RANDOM VARIABLES
Robert S. De Zur and James D. Donahue Wright-Patterson AFB, Ohio, ARL, Apr. 1965, 56 p refs
(Contract AF 33(615)-1023)
(ARL-65-71; AD-616742)

This report, prepared in two parts, deals with products and quotients of random variables. In Part I, the distributions of quotients of independent random variables are considered. In Part II, the distribution of the product of two (not necessarily independent) normally distributed random variates is investigated. The tables of this distribution are given in the Appendix. Author

N65-35646# California Univ., Los Angles.
CHARACTERIZATIONS OF STARSHAPED SETS
Eugene Elliot Robkin (Ph.D. Thesis) Jan. 1965 73 p refs
(Contract Nonr-233(76))
(AD-615041)

Several new concepts together with Helly's theorem and some of its relatives permit the characterization of several classes of star-shaped sets. Theorem proofs are also given to characterize sets which are star-shaped in a more general sense. In addition, the analog of Krasnosel'skii's characterization of compact star-shaped sets is developed for closed sets on an n-dimensional surface of a closed unit solid ball. L.S.

N65-35672# Texas Univ., Austin. Computation Center.
AN ERROR ANALYSIS OF KAISER'S ALGORITHM FOR DIAGONALIZING A REAL SYMMETRIC MATRIX
Houston I. Lewis, Jr. (M.A. Thesis) May 1965 71 p refs
(Grants NSF-GP-217; DA-ARO(D)-31-124-G388)
(TNN-44; AROD-3772-13; AD-617353)

This report describes an error analysis of Kaiser's algorithm for diagonalizing a real symmetric matrix. Use of the Kaiser algorithm to produce an eigenvalue is compared timewise with the Householder-Ortega algorithm. The divergence of maximal bounds for iterative processes from the actual cumulative errors as the number of iterations increases is considered. Author

N65-35682# Measurement Analysis Corp., Los Angeles, Calif.
AN ANALYSIS OF AMPLITUDE PROBABILITY MEASUREMENTS Technical Documentary Report, Mar.–Dec. 1964
George P. Thrall Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Mar. 1965 38 p refs
(Contract AF 33(615)-1418)
(MAC-403-01; FDL-TDR-64-116; AD-617611)

Techniques for measuring amplitude probabilities and probability densities are summarized, and previous results on the statistical uncertainty of such measurements are reviewed. A rigorous mathematical model of probability measurements is derived. It is shown that unknown correlations in the parameters of the model make it impossible to develop explicit expression for the mean square estimation error. Results are presented of a computer simulation of amplitude probability estimates, and comparisons are made between experimental and computed mean square errors. Author

N65-35748# California Univ., Berkeley. Operations Research Center.
LAPLACE'S EQUATION AND NETWORK FLOWS
T. C. Hu Feb. 1965 23 p refs
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-65-2; AD-615815)

This paper shows that partial differential equations may be a possible area of application of mathematical programming. The solution of Laplace's equation with Neumann's condition is shown to be a minimum cost network flow problem with cost proportional to the arc flow. An algorithm of solving minimum quadratic cost network flow is given. Author

N65-35768# Texas A&M Univ., College Station.
AN EXACT FORMULA FOR THE PROBABILITY THAT TWO SPECIFIED SAMPLING UNITS WILL OCCUR IN A SAMPLE OF TWO UNITS DRAWN WITH UNEQUAL PROBABILITIES AND WITHOUT REPLACEMENT
W. S. Connor [1962] 7 p refs
(Grant DA-ARO(D)-3-124-G93)
(AROD-2934-17; AD-616631)

Compact expressions, containing probabilities $P_{ii'}$ ($i \neq i'; i,i' = 1, \ldots, N$) where i and i' are both in the sample, are used for a population of N units, where a sample of n distinct units can be drawn in such a way that the probability π_i, ($i = 1, \ldots, N$) for the i-th unit in the sample is proportional to its size x_i. An exact formula for $P_{ii'}$ for the case where $n = 2$ and any value of N is derived, and the formula is illustrated by a numerical example for $N = 10$. L.S.

N65-35769# Wisconsin Univ., Madison. Mathematics Research Center.
ASYMPTOTIC SOLUTIONS OF SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS Technical Summary Report
W. A. Coppel Mar. 1965 18 p refs
(Contract DA-11-022-ORD-2059)
(MRC-555; AD-616874)

It is shown that the equation $y'' + f(x)y = 0$ has two linearly independent solutions satisfying for $x \to \infty$

$$y \sim [f(x)]^{-\frac{1}{4}} \exp\left\{ \pm i \int_{x_0}^{x} [f(\xi)]^{\frac{1}{2}} d\xi \right\}, y' \sim \pm i [f(x)]^{\frac{1}{2}} y,$$

if $f(x)$ is a real, non-vanishing, twice continuously differentiable function for $x \geq x_0$ such that

$$\int_{x_0}^{\infty} |f^{-3/2} f''| \, dx < \infty.$$

The result is obtained by specialization of more general results for the equation $(p(x)y')' + q(x)y = 0$. Its relationship to previous work in this field is discussed. Author

N65-35770# Wisconsin Univ., Madison. Mathematics Research Center.
SPECTRAL THEORY FOR THE WAVE EQUATION WITH A POTENTIAL TERM Technical Summary Report
D. Thoe Apr. 1965 83 p refs
(Contract DA-11-022-ORD-2059)
(MRC-562; AD-616865)

A spectral representation for the potentially-perturbed wave equation is given for a class of non-negative potentials which vanish at ∞. The proof depends for the most part on energy considerations. Author

N65-35771# Wisconsin Univ., Madison. Mathematics Research Center.
E-TRANSFORMS Technical Summary Report
F. M. Ragab Apr. 1965 23 p refs
(Contract DA-11-022-ORD-2059)
(MRC-563; AD-616872)

A new class of integral transform is established. Special choices of the parameters in this transform lead in turn to the derivation of Hankel transform, Y-transform K-transform, Fourier transform, Laplace transform and other new integral transforms which are illustrated by tables. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-34804# Air Force Cambridge Research Labs., Bedford, Mass.
PROCEEDINGS, 1964 AFCRL SCIENTIFIC BALLOON SYMPOSIUM
Arthur O. Korn, Jr., ed. Jul. 1965 439 p refs *Its* AF Surv. in Geophys. No. 167
(AFCRL-65-486; AD-619695)

Symposium papers are presented on advances in balloon design, materials, instrumentation, meteorology, and scientific applications. For individual titles see N65-34805–N65-34836.

N65-34823 Honeywell, Inc., St. Paul, Minn. Military Products Group Research Lab.
TOWARD IMPROVED MEASUREMENTS OF STRATOSPHERIC HUMIDITY WITH BALLOON-BORNE FROST-POINT HYDROMETERS
J. G. Ballinger, L. E. Koehler, M. P. Fricke, and R. D. Murphy *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 231–259 refs (See N65-34804 23-20)
(Contracts AF 19(604)-8418; AF 19(628)-3857; AF 19(628)-4206)

Efforts to increase the reliability of stratospheric frost-point measurements made with balloon-borne, automatic hygrometers are described. Two major problems limiting the accuracy of stratospheric data are examined quantitatively and shown to place very high requirements on the equipment used (1) unsatisfactory instrument performance due to low mass-transfer rates of water vapor and (2) bias due to contamination of the moist-air sample by vapor desorbed from the instrument package and vehicle. General measures to improve the quality of future frost-point data from all sources are recommended, and specific techniques adopted by the Honeywell group are reviewed. Equipment for upcoming AFCRL vertical soundings and long-duration horizontal flights with Alpha Radiation Hygrometers is described. Author

N65-34824 Air Force Cambridge Research Labs., Bedford, Mass.
AFCRL STRATOSPHERIC HUMIDITY PROGRAM
D. Grantham, N. Sissenwine, and H. Salmela *In its* Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 261–272 refs (See N65-34804 23-20)

After a review of past experimentation to determine the water vapor content of the stratosphere, the proposed humidity experiments are outlined. The effort will consist of a series of 25 vertical and 5 horizontal balloon flights. These will be launched at Chico, California. The proposed flight profiles are presented. The vertical flights will use 500 000 cubic foot, 1.5-mil polyethylene, valving-controlled balloons to carry a payload of 450 lb to 100 000 ft. Both ascent and descent will be less than 400 ft/min with emphasis placed on the data obtained on descent. The effort will also include instrumented horizontal flights of several days' duration. No payload recovery is anticipated. Observations of contamination due to the emission of tropospheric-absorbed water vapor are anticipated for the first two to three days of flight but at least a week of uncontaminated data are expected to follow the drying-out period due to solar baking. E.E.B.

N65-34872# Naval Postgraduate School, Monterey, Calif.
AN EXPERIMENT IN MODIFYING OBJECTIVE 500-mb CONTOUR ANALYSES USING TIROS IX NEPHANALYSES
Theodore C. Casimes and Jerry C. Swor (M.S. Thesis) 1965 71 p refs
(AD-618883)

One of the numerical operational products of the United States Navy Fleet Numerical Weather Facility (FNWF) is the objective analysis of 500-mb contours on a hemispheric basis. Up to mid 1965, this analysis has been accomplished without use of weather-satellite observations. The period of 14 thru 20 February 1965 is selected as an experimental test period for the purpose of modifying the FNWF 500-mb analyses in the sparse-data region of the central North Pacific Ocean at 00Z. Synoptic scale phenomena depicted on Tiros IX nephanalyses are used as basis for the analysis modification. Modified 24- and 48-hour prognoses are made and verified. Results are interpreted in light of the experimental nature of the project, restricted time interval selected and experience level of the authors in the field of satellite meteorology. Author

N65-34874# Naval Postgraduate School, Monterey, Calif.
A STUDY OF DIABATIC HEATING EFFECTS ON THE DEVELOPMENT OF PRESSURE WAVES
Elizabeth M. Barrett (M.S. Thesis) 1965 38 p refs
(AD-618882)

A baroclinic model programmed for numerical solution is used to investigate the effects of diabatic heating on the development of pressure waves for periods up to 24 hours. Several forms of the model are studied with results being obtained for various wavelengths. The results lead to some meteorological improbabilities; however, the relative development of the pressure wave appears valid for short time periods. Author

N65-34981# France. Direction de la Météorologie Nationale, Paris.
CONTRIBUTION TO THE STUDY OF CLIMATE AND WEATHER PREDICTION IN THE CENTRAL AFRICAN REPUBLIC [CONTRIBUTION A L'ETUDE DU CLIMAT ET DE LA PREVISION DU TEMPS EN REPUBLIQUE CENTR'-AFRICAINE]
E. Nevière Jul. 1965 53 p refs *Its* Monograph No. 43 In FRENCH CFSTI: HC $3.00/MF $0.50

A qualitative study of the hourly distribution of rain and stormy weather patterns observed in Bangui between 1947 and 1960 is presented. The results, considered both annually and on a month by month basis, appear in tabular and graphical form. Diagrams depicting the data are included and discussed in terms of seasonal meteorological conditions, and a practical method for predicting the weather in the Central African Republic is described. Transl. by G.A.L.

N65-34989# McGill Univ., Montreal (Quebec). Arctic Meteorology Research Group.
80 W MEAN CROSS-SECTIONS. TWO YEAR MEANS FOR 1959–61 AND AN EVALUATION OF THE THERMAL WIND APPROXIMATION
N. Payette and J. N. La Flamme Jul. 1964 85 p refs *Its* Publ. in Meteorology No. 68 Sponsored jointly by Defence Res. Board and AFCRL
(AD-461366) CFSTI: HC $3.00/MF $0.75

Mean seasonal cross sections along 80 degrees west were computed from daily analyzed charts from June 1959 to May 1961. Special numerical methods allowed the computation of means and standard deviations with respect to jet cores and

selected temperatures as well as the usual geographical means. The study parallels another from June 1959 to May 1960 and presents two year means where applicable and discusses the inter-year variation. Most of the mean cross sections show a great similarity between the two years in the lower atmosphere while in the stratosphere differing results were obtained. The thermal wind equation application to daily analyzed data provides the basis for computed ageostrophic wind fields. The numerical integration used in computing the geostrophic wind avoided any subjectivity but led to an upward amplification of the error field. The study shows the tropopause and the jet streams as generators of stong ageostrophic wind. The same equation applied to mean data shows a long period geostrophic balance, but there are significant seasonal differences and the tropopause remains a permanent zone of ageostropic wind. R.N.A.

N65-34993 # Wisconsin Univ., Madison. Dept. of Soil Science.
MOMENTUM TRANSPORT MEASUREMENT IN THE ATMOSPHERIC SURFACE LAYER WITH THE ANEMOCLINOMETER Final Report, 1962–1965
G. W. Thurtell and C. B. Tanner [1965] 34 p refs
(Grant DA-SIG-36-039-62-G25)
(AD-470370)

The anemoclinometer, a small spherical probe with pressure ports, was used to measure the wind velocity vectors, and the Reynolds' stress in the atmospheric surface layer. Rotation of the probe through a known angle and analysis of the pressure data to obtain the rotation angle in terms of the wind velocity vectors resulted in errors of approximately 0.05 percent. Calculations of the Reynolds' stresses and wind velocities from both cup anemometer wind profile data and from anemoclinometer data were compared, and a discrepancy of ± 0.28 dynes cm^{-2} was found between approximate and complete Reynolds' stress calculations for comparable periods. Anemoclinometer wind velocity measurements differed from the cup anemometer value by as much as 5.8 percent in one run. Comparison of the standard deviations of the three vector wind velocity components with established values indicated a good similarity. It was concluded that the anemoclinometer provides sensitive and accurate measurements of the vector components of wind velocity and the Reynolds' stress in the atmospheric surface layer. G.G.

N65-35106*# Chicago Univ., Ill. Dept. of Geophysical Sciences.
DEATH VALLEY TEMPERATURE ANALYSIS UTILIZING NIMBUS I INFRARED DATA AND GROUND-BASED MEASUREMENTS
Ronald M. Reap and Tetsuya Fujita Aug. 1965 24 p refs
(Grant NsG-333)
(NASA-CR-67228; SMRP-RP-45) CFSTI: HC $1.00/MF $0.50 CSCL 04B

During February 1965 a series of temperature and radiation measurements were made within Death Valley by Colorado State University. Members of the Satellite and Mesometeorology Research Project of the University of Chicago assisted in the field operations by precisely locating and photographing thermograph and surface temperature sites which had been established in the area. Since the measured temperatures depend upon instrument location, a detailed description is given of the terrain features surrounding the sites. A temperature analysis of Death Valley and the Sierra Nevada range was also made utilizing Nimbus I HRIR data and mean shelter temperatures recorded at five synoptic stations in the area. Author

N65-35163# Florida State Univ., Tallahassee. Dept. of Meteorology.
STUDIES OF TIROS DATA OVER THE TROPICAL ATLANTIC SUPPLEMENTED BY CONCURRENT AIRCRAFT PHOTOGRAPHY Final Report
N. E. La Seur and Edward J. Zipser Dec. 1964 132 p refs
(Grant WBG-16)

A research program to improve the interpretation of cloud photography from the TIROS meteorological satellite over tropical oceans is presented. A field program was undertaken to acquire supplementary conventional meteorological data, aircraft data, and ground or airborne cloud photographs pertinent to the interpretation of TIROS data in the tropical Atlantic in situations ranging from meteorologically undisturbed to hurricane. Towards this end, as much of the cloud photography as possible was planned to be nearly synchronous in space and time with satellite coverage. Details of the field program are discussed. Success was achieved in gathering a coordinated data sample. A number of case studies based on the data sample illustrate new aspects in interpreting satellite cloud photography. R.N.A.

N65-35206*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GEOGRAPHICAL VARIATIONS OF WIND LOADS ON VERTICALLY RISING VEHICLES
Robert N. Henry and James A. Cochrane [1964] 30 p refs Presented at the AMS 5th Conf. on Appl. Meteorology; Atmospheric Probl. of Aerospace Vehicles, Atlantic City, 2–6 Mar. 1964
(NASA-TM-X-54594) CFSTI: HC $2.00/MF $0.50 CSCL 04B

The variation in winds and resulting variations in wind loads on vertically launched vehicles for different worldwide geographical areas are investigated. Methods of determining possible alternate launch sites that offer distinct wind-wise advantages over presently used sites are discussed; reductions of 50 percent or more in statistically determined peak winds or in statistical values of wind shears at critical altitudes may be realized. Since peak winds and maximum shears are recognized parameters of wind-induced loading, the variations in peak loads that are expected at different launch sites should reflect significant changes in wind environment with geographical regions. For some particular vehicles, variation of a single parameter, such as maximum wind speed, will produce large differences in computed load histories. An interesting disclosure of subjecting a simulated large liquid propellant vehicle to various wind inputs is that the peaks of the load histories appear strongly related to maximum wind shears rather than to maximum wind. For most vertically rising vehicles, the causes of geographical loading variations should be some combination of differences in both peak wind and shears. Author

N65-35424# Travelers Research Center, Inc., Hartford, Conn.
PREDICTION OF WINTER AND SUMMER CYCLONES Technical Report, Oct. 1964–Jun. 1965
Frederick P. Ostby and Keith W. Veigas Bedford, Mass., AFSC, Electron. Systems Div., Jul. 1965 65 p refs Prepared for United Aircraft Corp., East Hartford, Conn. *Its* Publ.-7463-17
(Contract AF 19(628)-3437)
(ESD-TR-65-11; AD-618921)

This report presents results and equations for the 12-, 24-, and 36-hr prediction of cyclone displacement and change in central pressure for the Northern Hemisphere. For application of these equations to summer cyclones, the Northern Hemisphere was divided into six areas; for application to winter cyclones, only three of these areas were treated because the other three were covered previously. The technique employed

features a moving-coordinate grid system for predictor tabulation, and a screening regression analysis for the derivation of the prediction equations. These equations were tested on an independent data sample and yielded results superior to climatology for all areas tested. The incorporation of 500-mb perfect prognoses as predictors appeared to have only limited success.
Author

N65-35465# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Munich (West Germany).
ON THE METEOROLOGICAL CONDITIONS FOR THE USE OF SILVER IODINE FOR CLOUD MODIFICATION [DIE METEOROLOGISCHEN BEDINGUNGEN DES EINSATZES VON SILBERJODID ZUR WOLKENBEEINFLUSSUNG]
H. G. Müller and A. Jaffé Sep. 1965 51 p refs In GERMAN; ENGLISH summary
(DVL-430; DLR-FB-65-39)

Thirty-nine months of Munich radiosonde observations were evaluated to determine the interrelations between frequency of "seedable layers" of different thicknesses and the data on rainfall frequency and vertical stability characteristics. The conditions prevailing in very thick non-precipitating cloud layers are discussed in detail.
Author

N65-35550# Miami Univ., Coral Gables, Fla. Inst. of Marine Science.
MESO-SCALE SYNOPTIC ANALYSIS OF RADAR AND SATELLITE METEOROLOGICAL DATA Final Report
H. W. Hiser and H. V. Senn Feb. 1965 58 p refs
(Contract CWB-10622)
(ML-65167)

Nine case studies are presented in which rectified Tiros photographs of cloud patterns over the South Florida region are correlated with synoptic weather data and radar observations of precipitation on the meso scale. Tiros V, VI, and VII data from August 1962 through October 1963, including hurricane Ginny, were used in the study. Previous work in the development of an optical rectification and gridding system for satellite photographs is summarized; this rectification system is furhter evaluated as to accuracy and applications.
Author

N65-35588# McGill Univ., Montreal (Quebec). Stormy Weather Group.
FACSIMILE AND AREAL INTEGRATION FOR WEATHER RADAR, VOLUME ONE
Marceli Wein Apr. 1965 107 p refs *Its* Scient. Rept. No. 3, Vol. 1
(Contract AF 19(628)-2489)
(MW-40; AFCRL-65-339(I); AD-617600)

Because of the fluctuating nature of the radar echo from randomly distributed precipitation particles, several individual echo measurements have to be averaged to provide a meaningful estimate of intensity. Photography of a cathode ray tube inevitably provides some averaging by integration on film, over the area of the writing spot. Further areal integration has been achieved by rectangular scanning of fast-processed film at a rate of a few lines per second with a spot of diameter one-half mile. The effective area of integration by first writing and then reading the pattern is one square mile. The areally-averaged signals are subsequently stepped into seven levels, a factor 10 apart in received power, and displayed on a stepped grey scale on facsimile paper. This presentation is well suited for a visual quantitative estimate of echo intensity. Slow scanning results in a low frequency signal that can be sent over voice-quality telephone line to provide within minutes radar weather maps in grey scale at any number of remote facsimile recorders.
Author

N65-35601# McGill Univ., Montreal (Quebec). Stormy Weather Group.
INTERPRETATION OF THE FLUCTUATING ECHO FROM RANDOMLY DISTRIBUTED SCATTERERS: PART 3 Scientific Report No. 1
Paul L. Smith, Jr. Dec. 1964 74 p refs
(Contract AF 19(628)-2489)
(MW-39; AFCRL-64-1006; AD-614658)

That the radar echo from a weather target comprising a random array of scatterers exhibits pulse-to-pulse fluctuations is a well-established fact. The interpretation of the fluctuating echo is an important problem in radar meteorology. The problem is usually to estimate the long-term mean echo intensity by examining only a rather small number of echoes. This observer's problem is the principal subject of the present report. The solution to the observer's problem is obtained as a probability distribution of the long-term mean echo intensity. This distribution becomes narrower and more sharply peaked as the number of independent echoes measured increases. The exact form of the distribution depends on the assumed a priori probability distribution; however, the dependence becomes negligible when the number of echoes is sufficiently large. Averaging the echo intensities is the optimum method of processing the echoes; averaging intensity levels or amplitudes is less satisfactory. However, the loss of precision when intensity levels are averaged is small, and it may be offset by other advantages of the logarithmic scale.
Author

N65-35602# McGill Univ., Montreal (Quebec). Stormy Weather Group.
TWO STUDIES OF CONVECTION. [1]: A MODEL OF CONVECTION WITH ENTRAINMENT AND PRECIPITATION. [2]: HIGH RADAR ECHOES FROM ALBERTA THUNDERSTORMS
R. C. Srivastava and C. D. Henry Oct. 1964 143 p refs
(Contract AF 19(628)-249)
(MW-38; AFCRL-65-10; AD-616094)

A jet model of cumulus is studied assuming steady-state conditions and horizontally uniform cross-sections of cloud and environment. Numerical solutions, assuming an entrainment rate inversely proportional to cloud radius, show that for a given ambient lapse rate the cloud thickness depends mainly on mass flux at cloud base and relative humidity in lower levels. The modification of cloud properties by precipitation is studied. Rainwater contents exceeding 10 g kg^{-1} appear possible in layers a few kilometers thick. A model of cumulus having an inner region of upward motion and an outer region at rest is also studied. An investigation of some aspects of 112 of the highest and most severe Alberta thunderstorms, as viewed by radar, is carried out. Nineteen of the echoes penetrated the tropopause, and two distinct types of echo growth were observed in two different environments. Median tephigrams indicated that days with the highest echoes had significantly different low level temperature structures than days with considerably lower echo heights. The actual heights agreed quite well with those predicted by parcel theory, and updraft velocities of about 30 to 50 m sec^{-1} were calculated from parcel theory.
Author

N65-35689# Atmospheric Research and Development Corp., Kansas City, Mo.
TROPOPAUSE PENETRATIONS BY CUMULONIMBUS CLOUDS—II Scientific Report No. 2

Michael J. Long Apr. 1965 72 p refs
(Contract AF 19(628)-2454)
(AFCRL-65-331; AD-617726)

This report presents a four year climatology of penetrations of the tropopause by thunderstorm clouds at ten locations in the United States. WSR-57 radar data for 1961 through 1964 were used to determine the vertical extent of the penetrations. Most penetrations occurred during spring and summer during the hours of normal maximum thunderstorm activity. Tropopause penetrations (more than 5000 feet) are summarized by geographical areas, by months, and on a diurnal basis. There was no relationship between penetrations and the number of thunderstorms. Three years of data from USAF radar stations abroad suggest a very small number of penetrations in the tropics and high mid-latitudes. Changes in the height and character of the tropopause near penetrations were studied in two serial sounding situations. Author

N65-35693# McGill Univ., Montreal (Quebec). Stormy Weather Group.
FACSIMILE AND AREAL INTEGRATION FOR WEATHER RADAR, VOLUME II Scientific Report No. 3
Marceli Wein Apr. 1965 16 p For abstract see N65-35588
(Contract AF 19(628)-2489)
(MW-40, Vol. 2; AFCRL-65-339(II); AD-617688)

N65-35766# Electro-Optical Systems, Inc., Pasadena, Calif.
LASER METEOROLOGICAL RADAR STUDY Final Report, 1 Sep.–31 Dec. 1964
Ellis D. Harris, Leonard J. Nugent, and Glenn A. Cato Jan. 1965 113 p refs *Its* Rept.-5990 (Final)
(Contract AF 19(628)-4309)
(AFCRL-65-177; AD-615444)

Theoretical studies have been conducted to determine the feasibility of employing optical radar techniques for the remote measurement of atmospheric meteorological parameters. These studies show the feasibility of laser radar measurements of atmospheric density, wind velocity, and concentration of water vapor and other variable constituents. Methods of temperature measurement have been identified and are feasible with a foreseeable improvement in the state-of-the-art. An experiment is proposed to characterize atmospheric aerosol size distribution by means of polychromatic laser illumination. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-34819 Air Force Cambridge Research Labs., Bedford, Mass.
BALLOON LOCATING SYSTEM
R. J. Cowie, Jr. *In its* Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 169–185 (See N65-34804 23-20)

A balloon locating sytem that uses existing navigational aids is described. With slight modifications present VHF omnidirection range (VOR) equipment can be adapted for balloon use with existing Air Force data gathering and transmission facilities. The VOR equipment appears to be optimum in terms of economy, accuracy, reliability, and compatibility with existing balloon equipment. It provides balloon position data easily interpreted without complex data reduction methods and consistent accuracy with coverage superior to any balloon locating system in use today. R.N.A.

N65-34899# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF OPTIMIZATION TECHNIQUES APPLICABLE TO A NON-LINEAR, VELOCITY-DAMPED INERTIAL NAVIGATOR
John Louis Kalish and Charles Franklin Swift, Jr. (M.S. Thesis) Jun. 1965 130 p refs
(GGC/EE/65-8; AD-618684)

Two adaptive control techniques are used to damp a second-order velocity-damped inertial navigator. The first technique uses the square of the velocity error to vary the damping and the second technique uses the cross-coupling effects of the earth-level platform. An analog simulation is made to test the feasibility of the approaches taken and to find representative non-linearities and damping parameters in the adaptive loops. The system is then "flown" on the IBM 7094 computer. An actual undamped inertial navigation system sensor package, using strapped down sensors, had been previously flight-tested and the sensor outputs were stored on magnetic tape. The IBM 7094 computer is programed to accept this sensor information along with the adaptive loop damping information which allows the system to be tested under realistic flight conditions. Direct comparisons between the systems can then be made. A comparison of the undamped, adaptive damped, and constant damped position error curves shows that the adaptive damping improves the position uncertainty by approximately 70 percent over the undamped system and by approximately 35 percent over the best constant damped system. Author

N65-35158# Federal Aviation Agency, Atlantic City, N. J. Research Div.
VLF MULTI-RANGE NAVIGATION-FIX ERROR CONTOURS Final Report
Ronald Braff and Nathaniel Braverman May 1965 64 p refs
(RD-65-70)

The fix error (actually precision), for such systems, may be expressed statistically in terms of the precise bivariate equiprobability error density ellipse or by the simpler, but conservatively approximate, d_{rms} circle. This error is a function of the "angles of cut" of the lines of position, the standard deviation of the errors in determination of the distances (ranges) to the stations, and the degree of correlation of these distance determinations. Error isograms are available for the two-station case but are based on a flat earth approximation. Proposed VLF systems would employ long baselines where the flat earth approximation is shown to cause appreciable discrepancies. The equations for the constant-error contours are derived (based on a spherical earth) as a function of baseline length (and orientation where three stations are used) and the "angles of cut" of the lines of position. Various error isograms were computed and plotted through the use of a digital computer. A method for determining the area covered acceptably by two stations is given and three-station coverage characteristics are discussed. Author

N65-35283*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
A SIMULATOR STUDY OF THE SUPERSONIC TRANSPORT IN THE AIR TRAFFIC CONTROL SYSTEM

Richard H. Sawyer, Joseph W. Stickle, and Richard Morris [1964] 11 p Presented at the 16th Natl. Aerospace Electron. Conf., Inst. of Elec. and Electron. Engr., Dayton, Ohio, 11–13 May 1964
(NASA-TM-X-51544) CFSTI: HC $1.00/MF $0.50 CSCL 17G

A NASA-FAA cooperative program for studying the problems anticipated in integrating the supersonic transport (SST) with the air traffic control (ATC) system is described. The program employs a technique of operating a four-place SST simulator in a real-time traffic control environment created by ATC simulation facilities. Descriptions of the equipment, technique, and test program are provided. Author

N65-35428*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NEAR-OPTIMUM GUIDANCE—AN ANALYSIS OF FULL PENALTY
Lyle R. Dickey 23 Apr. 1965 16 p refs
(NASA-TM-X-53249) CFSTI: HC $1.00/MF $0.50 CSCL 22C

An explicit solution of the linearized equations of motion is used to obtain the deviations in end conditions, Δr and $\Delta\theta$, and the additional burning time, Δt, expressed as integrals of functions of thrust angle deviations, $\Delta\chi$. Under the constraint that $\Delta r = \Delta\theta = 0$, the calculus of variations is applied to minimize Δt. The resulting Euler–Lagrange equation evaluated at $\Delta\chi = 0$ gives a simple relationship which is used to show that Δt is a second order function of $\Delta\chi$. This function is evaluated numerically for the second stage of an early SA-6 design. Results show that, if the mission is accomplished, the thrust angle may differ by as much as 2 degrees throughout the second stage with a propellant penalty of only 34 pounds. It follows that the capability of meeting the mission is the prime requisite of a guidance function and optimality is then only a second order consideration. Author

N65-35570# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
NEW BASIC FLIGHT INSPECTION SYSTEM Final Report
J. A. Lovell, J. P. Bethel, J. G. Kahan, and R. O. Steen Mar. 1965 128 p
(Contract FA-64WA-5164)
(SRDS-RD-65-37)

A program was conducted to design an airborne system for FAA flight inspection of navigation-aid facilities. The system was specifically designed to perform the functions currently being fulfilled by the basic flight inspection system. The design was concerned with all common-system navigation aids; however, those of major concern were VOR, TACAN, VORTAC, ILS Localizer, and ILS Glide Slope. Sequential steps in the program were: evaluation of the technical requirements for the signal characteristics for each type of navigation-aid facility; interpretation of the technical requirements with reference to the measurements that should be made in the aircraft and how they should be made; bench tests and theoretical analyses, where applicable, to determine the feasibility of making these measurements in the manner required; and formulation of a system design for performing the measurements. Author

N65-35583*# National Aeronautics and Space Administration, Washington, D. C.
NAVIGATION BY ARTIFICIAL EARTH SATELLITES [NAVIGATIONSVERFAHREN MIT HILFE KUNSTLICHER ERDSATELLITEN]
H. C. Freiesleben Sep. 1965 12 p Transl. into ENGLISH of paper presented at the Symp. on Data Transmission and Space Navigation, Munich, 8 Apr. 1965
(NASA-TT-9559) CFSTI: HC $1.00/MF $0.50 CSCL 17G

The use of artificial satellites, both variable-orbit and stationary types, for position fixing in sea and air navigation is discussed, with a review of existing system such as the US Transit and Secor satellites. Future projects for navigation over existing ground stations and a world-wide network, using a 24-satellite system, are mentioned briefly. Use of high-orbit satellites with synchronized clocks and interrogation systems is mentioned. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-34796 National Lead Co. of Ohio, Cincinnati.
GRAIN SIZE STANDARDS FOR BETA HEAT-TREATED URANIUM FUEL CORES
M. H. Cornett *In* Nucl. Metals, Inc. Tech. Papers of the 18th Metallographic Group Meeting Aug. 1965 p 105–109 (See N65-34789 23-17) CFSTI: $2.25

Visual standards are presented for rating grain size at 3X of the following beta heat-treated uranium fuel cores: (1) oil-quenched, extruded tubular fuel cores, (2) quenched, rolled I&E fuel cores, and (3) water-quenched, rolled I&E fuel cores. Author

N65-34915# United Kingdom Atomic Energy Authority, Harwell (England). Engineering Div.
SOME MEASUREMENTS OF THE DAMPING CHARACTERISTICS OF URANIUM AND URANIUM CARBIDE FUEL PINS
H. J. Crawley and M. J. Parsons May 1965 18 p
(AERE-R-4873) CFSTI: HC $1.00/MF $0.50

A limited series of damping measurements was made on uranium metal and uranium carbide, with and without stainless steel cladding, for temperatures up to 750° C. Young's modulus was also calculated. Author

N65-34984# Atomics International, Canoga Park, Calif.
DEVELOPMENT OF THE THERMOELECTROMAGNETIC PUMP FOR THE 3-kwe MERCURY RANKINE SYSTEM
H. H. Hanlin 1 Sep. 1965 70 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11198) CFSTI: $3.00

A thermoelectromagnetic pump was developed to circulate the heat transfer fluid in a Rankine cycle, space power system. This device combines a dc conduction pump and thermoelectric generator into a single, all-metallic unit. The thermoelectric elements, chromel and constantan, extract heat from the fluid being pumped, convert a portion of it directly into electricity to supply the conduction pump, and reject the waste heat to the secondary working fluid, mercury, as it enters the boiler. This pump type offered the major advantages of no moving parts and complete sealing of the liquid metals for highest reliability and complete utilization of rejected heat

for highest system efficiency. The design performance objective of 1 psi, 12 gpm NaK-78 at 1200° F was achieved and an endurance run to 6000 hours was demonstrated. This report describes the complete development program, detailing the design method and equations, laboratory procedures and all important test results. Author

N65-35014# Pratt and Whitney Aircraft, Middletown, Conn.
DETERMINATION OF ABSOLUTE POWER IN SNAP-50 CRITICAL ASSEMBLIES BY Ba^{140} FISSION PRODUCT MEASUREMENTS
W. F. Welsh 30 Jul. 1965 78 p refs
(Contract AT(30-1)-2789)
(PWAC-474) CFSTI: $3.00

Absolute power of a SNAP-50 critical assembly is obtained by combining measurements of core center power density and relative power distribution normalized to core center. Fission products of Ba^{140} from an enriched uranium metal strip are used to measure core center power density; catcher foil techniques provide measurements or relative power distribution. The obtained absolute power level is associated with neutron level as recorded by neutron monitors of fixed geometry. Because the reading of each neutron monitor is directly proportional to power level, absolute power of subsequent runs can be determined from corresponding readings of linear neutron monitors. An equation is developed for finding the absolute power of an azimuthally symmetric cylindrical critical assembly; the required waiting time between uses of a uranium strip for power calibrations is discussed; and total absolute detection efficiency of a rectangular source and separability of relative power distributions into radial and axial components are considered. M.W.R.

N65-35029# Du Pont De Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
A COMPUTER CODE FOR ONE-GROUP FLUX CALCULATIONS IN THREE DIMENSIONS
J. C. English May 1965 27 p
(Contract AT(07-2)-1)
(DP-938) CFSTI: $2.00

A computer code has been written in Fortran II to solve the one-group neutron diffusion equation over a triangular network of points in two- or three-space dimensions by relaxation methods. The network can contain up to 817 grid points in the R-θ plane and up to 16 horizontal levels. Typical computation time on the IBM 704 ranges from 43 to 255 minutes as the number of grid points vary from 3500 to 13000. Author

N65-35140# Oak Ridge National Lab., Tenn.
TIME STUDY OF FUEL ROD FABRICATION IN THE KILOROD FACILITY
J. E. Van Cleve, Jr., J. J. Varagona, and A. L. Lotts Oct. 1965 65 p refs
(Contract W-7405-ENG-26)
(ORNL-3740) CFSTI: $3.00

A time and motion study of fuel rod fabrication in the ORNL Kilorod Facility was performed to aid in the understanding of the process system and to serve as a guide in the extrapolation of data to larger and more sophisticated facilities. The Kilorod operation was divided into 28 operational subroutines composed of over 200 production work elements for which time values were determined. The maximum throughput of the system was determined to be 15.5 rods/day and the maximum crew effectiveness to be 87%. Author

N65-35155# Battelle-Northwest, Richland, Wash.
INSTRUMENTATION DEVELOPMENT FOR THE CONTAINMENT SYSTEMS EXPERIMENT
C. E. Huck 3 Feb. 1965 8 p refs
(Contract AT(45-1)-1850)
(BNWL-26)

An instrument development program and the detailed instrumentation requirements for a containment systems experiment are described. This will include a number of test runs in which several nuclear reactor containment concepts will be evaluated during simulated reactor coolant line ruptures. Development, testing, and adaptation of components will be required. A large number of variables such as temperature, pressure, stress, liquid level, humidity, discharge rate, and impact will be measured during the dynamic runs. The required specifications and development of the transducers and signal transmission systems for reading into the peripheral equipment of a digital computer are included. C.T.C.

N65-35164# Sandia Corp., Albuquerque, N. Mex.
DEVELOPMENT AND TESTING OF A RECOVERY SYSTEM FOR THE SNAP-10A RE-ENTRY VEHICLE
M. T. Kane, H. E. Widdows, and H. Lucero Apr. 1965 18 p
(Contract AT(29-1)-789)
(SC-DR-64-578)

The design, construction, and testing of a recovery system for the SNAP-10A flight, RFD-I, is presented. The system consists of a 7-foot constructed diameter, solid, flat, circular parachute and a 5.7 cubic foot CO_2 inflated flotation bag. A comprehensive test program was conducted to assure realiability of the system; however, recovery of RFD-I was not achieved. Some changes to the recovery system for future RFD flights are suggested. Author

N65-35183# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
^{60}Co HEAT SOURCES FOR 10–60 kw(e) GENERATORS
Arthur H. Dexter Jul. 1965 10 p refs
(Contract AT(07-2)-1)
(DP-974) CFSTI: $1.00

A feasibility study was made to determine the applicability of radioisotopes as a source of energy for small reactors. It was found that ^{60}Co is the isotope that can be used most cheaply to provide power units in the multikilowatt range. Large ^{60}Co heat sources require shielding weights comparable to the weight of shadow shielding for a reactor-type SNAP. Calculations for a permanently shielded ^{60}Co source with a maximum dose rate of 10 mR/hr showed that a spherical source of ^{60}Co with a diameter of 4.9 inches would provide the initial heat output of 55 kw(t) and would weigh only 20 lb. G.G.

N65-35331# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
EVESR-NUCLEAR SUPERHEAT FUEL DEVELOPMENT PROJECT: DARE CODE FOR THE THERMAL HYDRAULIC FUEL PERFORMANCE EVALUATION
B. G. Atraz [1964] 190 p refs
(Contract AT(04-3)-189)
(GEAP-4772)

The objective of the development program was the demonstration of satisfactory operation of superheat fuel elements of economic potential and an understanding of the design limits for superheat fuel to be used in commercial nuclear power reactors. The three major problems associated with the development of nuclear superheat fuel are: (1) stress corrosion

cracking of the clad material; (2) strain cycle fatigue in the clad material; and (3) contamination carry-over. The principle variables selected for evaluation were nuclear fuel cladding materials, fuel cladding operating temperatures, and fuel cladding strain levels as set by the heat flux and cladding combinations. The detailed operating conditions were analyzed by a computer code which used as input the pressure, temperature, and flow rate for fuel bundles measured in the exit piping outside the reactor vessel. The test irradiation procedures, data reduction and retrieval, instrumentation, and codes are discussed E.E.B

N65-35350*# Space Technology Labs., Inc., Redondo Beach, Calif.
MISSION ORIENTED ADVANCED/NUCLEAR SYSTEM PARAMETERS STUDY. VOLUME I: SUMMARY TECHNICAL REPORT Final Report, Apr. 1963–Mar. 1965
A. R. Chovit, R. K. Plebuch, and C. D. Kylstra Mar. 1965 75 p refs
(Contract NAS8-5371)
(NASA-CR-67316; STL-8423-6005-RU000, Vol. 1) CFSTI: HC $3.00/MF $0.75 CSCL 21F

A summary of the study approach, basic guidelines, and assumptions that were used in a comprehensive, parametric lunar and interplanetary mission and solid core, nuclear engine analysis are given. The analyses performed and the analytic techniques generated in developing three analysis computer programs for the IBM 7094 are summarized. These three programs, the SWingby Optimization Program (SWOP), the FLyby Optimization Program (FLOP), and the Nuclear Rocket Engine Optimization Program (NOP) were employed to generate over 20 000 mission simulations, and to investigate the effect on engine and vehicle performance of variations in nuclear engine design parameters and constraints. A summary of the results is presented which establishes an optimum thrust range for the advanced nuclear engine, determines the design characteristics of a compromise advanced nuclear engine, and establishes the sensitivity of the vehicle to variations in mission, engine, and vehicle parameters and modes. Author

N65-35372# Martin Co., Baltimore, Md. Nuclear Div.
RE-ENTRY DISPERSION MECHANICS OF PuO_2 MICROSPHERES
T. Olsen and L. Sullivan Feb. 1965 23 p refs
(Contract AT(30-1)-3169)
(MND-3169-47)

A physical model for predicting the reentry trajectory and subsequent ground location of microspheres, under specified conditions including horizontal winds, is described. Physical equations are given, and the Unitrac system is used to automatically generate a Fortran II assembly of fourth-order Runge–Kutta difference formulas for solving them. Atmospheric and aerodynamic parameters are also formulated, and wind data, ground deposition, and particle breakup considerations are defined. Microsphere deposition was calculated for release at various points along the fuel capsule reentry trajectory, and reentry characteristics for 10μ and 100μ radius spheres are tabulated. It was noted that the greatest horizontal displacement and deposition corridor width occur with maximum ablation: ablation reduces particle size and therefore increases descent time. Data are also included on kinetic thickness and drag coefficient; on the properties and constants used in the study; methods for determining the melting and ablation of PuO_2 microspheres, and the descent of PuO_2 microspheres through a stagnant atmosphere. Results are to be applied to safety studies for the SNAP 19 generator. M.G.J.

N65-35400*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLOW SYSTEM STARTUP OF A FULL-SCALE SIMULATED NUCLEAR ROCKET ENGINE
Benjamin H. Colmery and Albert G. Powers Washington, NASA, 1965 Presented at the 12th Nucl. Sci. Symp., Inst. of Electrical and Electron. Eng.
(NASA-TM-X-52139) CFSTI: HC $1.00/MF $0.50 CSCL 21F

The performance of the liquid hydrogen flow system during the startup transient of a nuclear rocket was measured in a full-scale simulated engine system at Lewis Research Center. In-flight exhaust conditions were approximated by maintaining a nozzle outlet pressure of 1 psia. Data and general conclusions on overall system performance are presented for nonnuclear operation. The ability of the rocket system to bootstrap (i.e., to build up appreciable hydrogen flow and pressure in the nuclear reactor without extra-system assistance) was clearly demonstrated by using only the energy from hydrogen tank pressure and latent heat of engine components. The severity (small) and characteristics of two-phase flow oscillations during windmill were determined. No significant operational problems were encountered Author

N65-35410*# Space Technology Labs., Inc., Redondo Beach, Calif.
MISSION ORIENTED ADVANCED NUCLEAR SYSTEM PARAMETERS STUDY, VOLUME VI Final Report, Apr. 1963–Mar. 1965
A. R. Chovit and R. R. Plebuch Mar. 1965 17 p
(Contract NAS8-5371)
(NASA-CR-67317; STL-8423-6010-RU-000, Vol. VI) CFSTI: HC $1.00/MF $0.50 CSCL 21F

Development of future space technology, supplementary research on alternative operational and system techniques, and specification of vehicle weight requirements and subsystem performance characteristics are considered in relation to parameters for lunar and interplanetary missions. Selection of the nuclear engine design for such missions is discussed in terms of design constraints, achievable engine performance, and engine firing times. Launch weight, aerodynamic braking, and mission year are considered as the areas which exert the greatest influence on overall mission performance characteristics; and a table gives the variation of vehicle weight (1) with mission year, (2) with earth aerodynamic braking capability, and (3) as a function of mass fraction and mission year. Vehicle weight is graphed against (1) nozzle chamber temperature and expansion ratio and (2) specific impulse and nozzle chamber pressure. Also considered are Mars aerodynamic braking, Venus swingby missions, clustered engines, modular stage designs, and launch windows and holds. Mission subsystem requirements are listed. M.W.R.

N65-35439# Oak Ridge National Lab., Tenn.
OPERATING EXPERIENCE OF THE NUCLEAR SAFETY INFORMATION CENTER, MARCH 1963–MARCH 1965
J. R. Buchanan and William B. Cottrell 17 May 1965 33 p refs
(ORNL-TM-1136)

This report is a review of the first two years of Nuclear Safety Information Center (NSIC) operation. It describes the services that the center offers, the manner in which it operates, and problems it has encountered. NSIC stores its information both in a manual file and, since September 1964, on magnetic tape at the Oak Ridge IBM-7090 facility. The efficient services made possible by the computer are described. Author

N65-35444# Battelle-Northwest, Richland, Wash.
MONTE CARLO CALCULATED MATERIAL BUCKLINGS OF 3 WT% ENRICHED URANIUM-WATER LATTICES WITH URANIUM IN THE WATER MODERATOR
L. L. Carter Sep. 1965 36 p refs
(Contract AT(45-1)-1830)
(BNWL-127) CFSTI: $2.00

Monte Carlo calculations are presented for 3 wt% enriched solid rod uranium lattices with uranium in the water moderator in order to demonstrate that the maximum material buckling which can be obtained at this enrichment occurs when the uranium is absent from the moderator. While the addition of uranium to the water moderator will increase the material buckling of lattices of certain fuel rod diameters and moderator-to-uranium volume ratios, the obtained calculations indicate that the material buckling will never exceed that of a clean 3 wt% enriched lattice at the optimum diameter and ratio. Calculated material buckling values for the clean water lattices are somewhat lower than experimental values; these calculations neglect any effect from nitrogen and other poisons that are present in experimental situations. Error analysis is considered; and, other than statistical error, the dominant error is caused by the cross sections used. Descriptions of the lattice Monte Carlo code and Fortran II program are given; and experimental and Monte Carlo calculated parameters for uranium-water lattices are tabulated. M.W.R.

N65-35470# European Atomic Energy Community, Brussels (Belgium).
PIN-TO-PIN INTERACTIONS IN FUEL CLUSTERS, PART I
L. Amyot 1965 25 p
(EUR-2470.E) CFSTI: HC $1.00/MF $0.50

The rigorous evaluation of the pin-to-pin collision probabilities in fuel clusters involves the calculation of double integrals. Because of the relatively long machine-time required, it is desirable for routine type calculations to have at one's disposal quicker recipes which do not imply too great a sacrifice in accuracy. In the present paper, an approximate formula is derived analytically from the exact expression for the case when the optical distance between source and target pins does not vary to any great extent with the direction of the neutron path. Numerical results show that the new equation will be of particular advantage in the fast energy range. Author

N65-35546# Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM Quarterly Progress Report, 1 Apr.–30 Jun. 1965
R. H. Chesworth 13 Aug. 1965 103 p refs
(Contract AT(10-1)-880)
(IDO-28649) CFSTI: $4.00

Development continued on a mobile low power nuclear power plant for military field operations. The ML-1 pressure vessel leak was repaired and low power tests for rod calibration and reactivity coefficient determination were completed. During testing, an analog computer was connected to selected reactor operating instrumentation systems to permit the direct derivation of rod calibration curves and reactivity coefficient values. The CSN-1A t-c set was disassembled and inspected, and several components were redesigned to improve its aerothermodynamic performance. The fin-plate precooler for the ML-1 was assembled and tests of the air-side system revealed that the air flow rate was approximately 20% greater than the design value. Alternator testing was completed. A test program to check out and calibrate the components of the GDF lubrication system was initiated. The metallurgical evaluation of the failed pin from the IB-17R-3 test element revealed that the failure resulted from oxidation of a defect in cladding. The limited evaluation of ML-1 pressure vessel technology was completed and the conceptual design of an advanced pressure vessel was developed. R.N.A.

N65-35547# Pratt and Whitney Aircraft, Middletown, Conn.
THE REACTOR WEIGHT OPTIMIZATION PARAMETRIC CODE—WOP
R. W. Fish and R. E. Killen 29 Jul. 1965 70 p refs
(Contract AT(30-1)-2789)
(TIM-807)

A weight optimization parametric code (WOP) for optimizing reactors on the basis of minimum weight, while matching desired operating conditions and remaining within imposed operating limitations is discussed. The WOP calculates reactor weights and dimensions from input physics data, desired operating conditions, and material properties for all reactors within the input ranges of up to four independent physics variables. The code then selects the minimum weight reactor satisfying all input operating limitations from all the reactors considered. The WOP consists of a main program and several subroutines which contain the logical procedures for selecting the minimum weight reactor from all those considered, plus a subroutine which performs the reactor engineering calculations. Further descriptions of the code, and equations used are given; and all symbols used in the discussion and equations are defined. A sample computer program is presented. L.S.

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-34901*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A FIGURE OF MERIT MEASURING PICTURE RESOLUTION
T. Rindfleisch and D. Willingham 1 Sep. 1965 59 p refs
(Contract NAS7-100)
(NASA-CR-67187; JPL-TR-32-666) CFSTI: HC $3.00/MF $0.50 CSCL 12A

A mathematical formalism is developed which leads to a single number or figure of merit measuring a characteristic dimension of the smallest detectable object in a picture of an extended complex scene. The formalism is in modular form and can include the effects on the system resolution due to statistical and photometric properties of the surface being viewed, atmospheric turbulence, image motion, characteristics of the television and recording system, system noises, and properties of the human observer. The treatment is unified within the framework of linear system analysis and assumes that portions of the transfer process act as spatial filters and that the human observer functions as a signal-to-noise optimizing lowpass filter. The contrast present in the object scene is determined by the statistical and photometric properties of the scene. A comparison of the figure of merit to conventional resolution measures is made. Author

N65-34948*# Alabama Univ., University. Dept. of Physics.
OPTICAL PROPERTIES OF TRANSITION IONS IN CRYSTALS UNDER BOMBARDMENT BY ENERGETIC PARTICLES, X AND GAMMA RAYS AND LIGHT Final Report
Edward H. Carlson 15 Sep. 1965 8 p refs
(Contract NAS8-11200)
(NASA-CR-67205) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Studied were radiationless processes and their effects on the lifetimes of the radiating states of crystals containing rare earth ions after excitation by flash lamp. Time resolved spectroscopy of the fluorescent intensity by pulsed photomultiplier detector was used to obtain life rise times for Sm^{2+}, and fall lifetimes for Pr^{3+}:$LaCl_3$, Nd^{3+}:$LaCl_3$, and Sm^{2+}:$LaCl_3$, at 77° K, and at 4.2° K. Also determined was the excitation spectrum of Sm^{2+}. Temperature measurements on the Sm^{2+}:$LaCl_3$ lifetimes found a striking dependonce which indicates a multiphonon process. At 4.2° K, no initial rise in fluorescence intensity as a function of time after the flash could be seen, and decay lifetimes were 10 msec, and 2 msec for the A and B levels, respectively. At 77° K, the fluorescence from A showed an initial rise with a lifetime of 50μsec and a decay of 3.5 msec. The B level showed only a decay time of 2.1 msec. G.G.

N65-34953* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIFFRACTION PROFILES PRODUCED BY BERYLLIUM-WINDOW SAMPLE CUPS
N. Nickle *In its* Lunar and Planetary X-ray Diffraction Program 1 Jun. 1965 p 33–36 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

In general, beryllium-window sample cups produce a typical diffraction profile with the same peaks for each cup. The angular position and intensity of the peaks vary from cup to cup, depending upon the uniformity in manufacture, foil thickness, and degree of preferred orientation of the crystallites in the foil. The CuK$^{\alpha}$ diffraction peaks of the foil are tabulated. In addition to the peaks, there exists a very broad diffraction maximum similar in appearance to that produced by glass or other amorphous material. Its intensity reaches a maximum of 5 to 10 cps at 17° and decreases to background level at about 10° and 30° -2θ. Diffraction peaks produced for five conditions by the inner vertical walls of an empty, all-beryllium sample cup are shown. Superimposed on the diffraction maximum is an intense peak that appears at 16.5° $-2\ \theta$, which is produced by the inner vertical beryllium walls of the cup. This peak does not appear when a sample is in the cup since the powdered material covers these surfaces. E.E.B.

N65-34954* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPARISON OF PERFORMANCE CHARACTERISTICS FOR BERYLLIUM (002) REFLECTION
N. Nickle *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 37–38 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

A test was made to show existing differences in the beryllium(002) reflection parameters between all available beryllium-window sample cups. The Be(002) reflection that exists as a strong peak at about 2000 cps in all beryllium-window cups is intended to serve as an internal standard during modal analysis on the lunar surface. The centroid of this peak will act as a reference from which other peaks can be measured accurately. Peak parameters of the Be(002) reflection are shown for six all-beryllium and for five aluminum-frame sample cups. Each cup was scanned 10 times, reversed in the goniometer and scanned again. The most pronounced difference between the two types was in peak intensity. The aluminum cups averaged 19.6% greater intensity than the beryllium cups. Resolution measurements were more consistent for the beryllium cups. Symmetry measurements were also more consistent for the Be cups. The Be-window sample cups displayed unique characteristics for the Be(002) reflection. The most significant variation was the 2θ angle at which the peak appears. E.E.B.

N65-34955* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
QUARTZ AND BERYLLIUM PEAK PARAMETERS VS TEMPERATURE OF BERYLLIUM FOIL
N. Nickle *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 39–43 (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

An all-beryllium sample cup packed with quartz particles less than 37 microns was heated in the diffractometer by means of a heating element attached to the sample carriage. Changes in the peak parameters for the quartz(100), quartz(101), quartz(312), and Be(002) reflections were consistent, although the magnitude of the changes varied. The changes in peak parameters for a change in temperature of 100° C are given. Diffraction is caused by scattering of X-ray photons by the outer-shell electrons of the atoms in the crystal lattice. Resolution increased slightly with the temperature change of 100° C, ranging from 2.7% to 9.8%. Peak symmetry showed a significant and systematic change when the cup and sample were heated from 25° to 125° C. For each peak measured, the symmetry became skewed toward lower 2θ angles. The most significant change was the shift in the centroid of the peak. Calculations show how the displacement of the sample surface will shift the angular position of the peak at various scattering angles. E.E.B.

N65-34963* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SEEMANN–BOHLIN OPTICS FOR X-RAY POWDER DIFFRACTOMETRY
J. A. Dunne *In its* Lunar and Planetary X-Ray Diffraction Program 1 Jun. 1965 p 129–142 refs (See N65-34950 23-14) CFSTI: HC $5.00/MF $1.25

The results of an investigation of the geometric properties of the Seemann–Bohlin arrangement as compared with the conventional Bragg–Bentano diffractometer design are presented. Resolution and intensity ratios for the systems are given. The general feature of the Seeman–Bohlin geometry is the utilization of true focusing in the principle plane of diffraction which allows a large divergence angle with resultant gains in intensity per unit resolution. Thus, the image is formed at all positions along the focusing circle by beams diffracted from the sample. E.E.B.

N65-35048# North Carolina Univ., Chapel Hill.
[QUANTUM THEORY; RELATIVISTIC MECHANICS; SPINOR-TENSORS] Joint Report, 1 Dec. 1964–31 May 1965
Bryce S. De Witt [1965] 13 p refs
(Contract Nonr-855(07); Grant AF-AFOSR-153-63)
(AD-619183)

Abstracts on quantum theory, relativistic mechanics, and spinor-tensors are presented. Abstracts are included on the inner product in the canonical quantum theory of gravity, radiation dumping in a gravitational field, classical relativistic mechanics of interacting point particles, the conceptual basis and use of the geometric invariance principles, a theorem on spinor-tensors, identities for the curvature tensors in non-Riemannian geometries, conformal and projective Riemann spaces, pedagogical methods in relativity theory, and photon bound states and gravitons. R.N.A.

N65-35179# Weapons Research Establishment (Australia). Dept. of Supply.
PLASMA PROBES AND THE LANGMUIR PARADOX
E. H. Hirsch Jul. 1965 18 p refs
(WRE-TN-CPD-100) CFSTI: HC $1.00/MF $0.50

Experiments show that in a low pressure plasma the apparent electron temperature inferred from Langmuir probe measurements is not a direct index of the mean electron energy within the plasma. Electrons undergo energy transfer through radio frequency interactions in the probe sheath and in the sheaths on the plasma boundary. Consequently the apparent electron temperature depends on the resonant properties of the sheaths and on the geometry of the probe. By altering the resonant properties of a sheath it is possible to change the apparent electron temperature without affecting the electron energy distribution within the plasma itself. Author

N65-35257*# University of Southern Calif., Los Angeles. Dept. of Physics.
INSTRUMENTATION PROBLEMS IN THE VACUUM ULTRAVIOLET BELOW 1000Å
G. L. Weissler 1 Jun. 1964 14 p refs Presented at Intern. Conf. on Phot. and Spectroscopic Optics, Tokyo and Kyoto, 1–8 Sep. 1964
(Grant NsG-178-61)
(NASA-CR-56923) CFSTI: HC $1.00/MF $0.50 CSCL 20F

An analysis of improved methods and techniques for use in solving inherent instrumentation problems in the vacuum ultraviolet below 1000-Å, is presented. Discussed are several detection systems and methods for increasing their sensitivity such as the separation and shielding of pulsed sources, and synchronous shielding techniques. S.C.W.

N65-35321# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Optics Div.
THE MOBILITY OF RIGID LEVERS
James C. H. Hoge 6 Oct. 1964 9 p refs
(TM-64-4; AD-465583)

Several forms of a transfer function for mechanical systems were advocated for the solution of problems of mechanical systems with lumped parameters. The results were shown to be identical. An expression was derived for the mobility of a rigid lever with a finite number of discreet attached mobilities, and which stated that the mobility of an element is the ratio of the relative velocity between one of its terminals and its other terminal to the force acting through the element. The development of an infinite series solution for the mobility of a rigid lever is presented with units and symbols used throughout and given in table form. R.W.H.

N65-35336# Los Alamos Scientific Lab., N. Mex.
THE ELECTRICAL CONDUCTIVITY OF SOME CRYOGENIC FLUIDS
Walter L. Willis (M.S. Thesis—N. Mex. Univ.) 1965 48 p refs
(Contract W-7405-ENG-36)
(LA-DC-7026)

The electrical conductivity of several cryogens was measured to determine whether electrostatic potentials can be generated. An apparatus was designed to condense and hold a cryogen sample. An equation was derived for the material resistivity in terms of geometry and resistance measured through the sample. The resistance was determined by measuring the current produced by a know potential difference using an electrometer amplifier, and by observing the decay of an applied charge with an electrostatic voltmeter. Measurements were made on liquid hydrogen, deuterium, argon, nitrogen, carbon monoxide, and chlorotrifluoromethane. The resistivity or conductivity of the cryogens appears to be a function of the applied voltage gradient. It is postulated the cryogens are intrinsically perfect insulators. Observed conduction is believed to be due to the presence of charge carriers produced by ionizing radiation present as natural background. R.N.A.

N65-35349# TRACOR, Inc., Austin, Tex.
AN ANALYTICAL SOLUTION TO THE SOUND PRESSURE FIELD RESULTING FROM A PLANE WAVE INCIDENT ON AN ELLIPTIC CYLINDER AND A RIGHT CIRCULAR CYLINDER
P. G. Hedgcoxe 17 Feb. 1965 14 p refs
(Contract NObsr-91229)
(TRACOR-64-117-U; AD-619277)

An analytical method is described for obtaining the scund pressure field due to a plane wave incident on a complex consisting of an infinite length elliptical baffle and an infinite length right circular cylinder. The problem is formulated so that the baffle shields the cylinder from the incident plane wave. The model used for this boundary value problem is a generalization of a previous concentric baffle model used for studying the interaction of the sonar baffle and transducer with screw noise. Analytical results are presented in a form suitable for computing the total sound pressure at the transducer face as well as the incident and reflected portions of the field solution there. R.N.A.

N65-35357*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF SONOTONE CORPORATION 5.0 AMPERE-HOUR NICKEL CADMIUM CELLS
E. C. Breuss 2 Sep. 1965 12 p
(NASA Order W-11252-B)
(NASA-CR-67350) CFSTI: HC $1.00/MF $0.50 CSCL 10A

To obtain specification information concerning secondary spacecraft cells, acceptance tests were performed at an ambient temperature between 23° and 27° C at existing relative humidity and atmospheric pressure. Charging and discharging was done at constant current (±5 percent), and cells were charged in series but were discharged individually. A brief description of phenolphthalein leak, capacity, cell short, immersion seal, overcharge, and internal resistance tests is included. Results showed no leakage of the ceramic seals, and cell capacity was in the acceptable range of 5.05 to 6.80 ampere-hours to 1.00 volt. M.G.J.

N65-35368# Aerojet-General Corp., Downey, Calif. Research and Engineering Div.
INVESTIGATION OF COALESCENCE OF SOLID-LIQUID SYSTEMS
R. L. Mac Lean and T. A. Gaukler 28 Apr. 1965 27 p refs /*ts* Rept.-0780-01 (02)FP
(Contract AT(04-3)-474)
(TID-21855)

Controlling mechanisms for coalescence of water with solids were studied by means of high-speed photographic measurements. The time between apparent contact to the first appearance of coalescing neck or lens was used as an indication of mechanism rates for initiation coalescence. This time period must be relatively short to ensure that solid particles and droplets will coalesce after impact before rebounding and separating. Measurements were made for water and difference solids such as glass, alumina, agate, and carbon.

From the experimental data, it is concluded that the chemical nature of a solid in coalescence with water has some effect on the coalescence rate. The effect of surfactant coatings on the solids was measured and found nonconclusive as to mechanism influence. Measurements conducted on two different types of carbon suggested that either a surface topography or a minor compositional factor causes a marked change in coalescence delay time. Author

N65-35421# Rocketdyne, Canoga Park, Calif.
RESEARCH ON SPECTRAL ANALYSIS: SUMMARY OF RESULTS, 15 JUNE 1964–30 JUNE 1965
N. R. Goodman and M. R. Dubman 30 Jul. 1965 21 p refs
(Contract Nonr-4557(00))
(R-6265; AD-619265)

The intensification of interest in non-stationary processes has been prompted to a great extent by two complimentary motives: the direct observation in applications of time series which are clearly not stationary and the natural mathematical desire to generalize the already existing rich (and useful) theory of stationary processes. It was the former which originally motivated the latter, leading some years ago for example to the notion of "Spectra of Spectra" or more properly spectra of power fluctuations. More recently attention has been directed towards the development of statistical tests for stationarity which implicitly provide a characterization and even perhaps estimation of the nature of the nonstationarity. Towards this end a variety of models of nonstationary processes have been studied and quantitatively compared. In addition several estimation problems have been considered and recent results of these investigations are summarized. Included are discussions of the following: (1) the spectral characterization and comparison of nonstationary processes; (2) statistical tests for nonstationarity of time series; (3) spectra of time varying spectral measurements; and (4) estimation problems for processes of normal type. Author

N65-35432# Naval Research Lab., Washington, D. C.
A REVIEW OF WORLD CONTRIBUTIONS FROM 1945 TO 1965 TO THE THEORY OF ACOUSTIC RADIATION. CHAPTER 1: INTRODUCTION TO THE FUNDAMENTALS OF ACOUSTIC RADIATION
S. Hanish 8 Jun. 1965 110 p refs
(NRL-MR-162; AD-619242)

The first of a series of reports designed to review, digest, and present advances in acoustic radiation theory is presented. Discussions are included on acoustic intensity, power, the wave equation, Green's functions, transients, creeping waves, lateral waves, variational principle, directivity functions, impedances, and other radiation parameters. R.N.A.

N65-35445# Michigan Univ., Ann Arbor.
OPTICAL RECTIFICATION
Michael Bass (Ph.D. Thesis) [1964] 52 p refs
(Contract AT(11-1)-1112)
(TID-21807)

Optical rectification, or the dc effect, was studied in crystals of KDP (potassium dihydrogen phosphate), deuterated KDP, CdS, $Cd(S_{0.75} + Se_{0.25})$, and ZnTe using a one megawatt beam from a ruby laser. The detection procedure entailed mounting the crystal as the dielectric in a parallel plate capacitor and measuring the voltage induced by the dc polarization. The relation between optical rectification and the linear electro-optic effect was experimentally verified in KDP and deuterated KDP. Available linear electro-optic data for these crystals predicts values for their dc coefficients in good agreement with the measured results. The temperature dependence of the dc effect in these crystals was identical with that of the linear electro-optic effect in the range from 120° to 300° K. The quantum mechanical prediction was verified in CdS, $Cd(S_{0.75} + Se_{0.25})$, and ZnTe. These crystals have optical absorptions nearer the ruby laser frequency than does KDP, and exhibit larger optical rectification coefficients. A large interferring signal observed in KDP using the neodymium laser may be due to a tertiary pyroelectric effect in the crystal stimulated by absorption of some of the laser beam energy. R.N.A.

N65-35529# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CRYSTAL LIGHT MODULATOR
A. S. Nakonechnyy 11 Aug. 1965 5 p Transl. into ENGLISH from Russian Patent no. 166384 (Appl. no. 847083/26-25, 12 Jul. 1963) 2 p
(FTD-TT-65-527/1+2+4; AD-619317)

The crystal light modulator is distinguished by the fact that, with the aim of lowering the voltage in order to obtain a variable movement between an ordinary and extraordinary ray; it uses a multilayered prism made of crystal plates, which are staggered with electrodes. Author

N65-35551# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN INVESTIGATION OF THE MOTION OF A CABLE CONNECTED DUMBBELL SPACE VEHICLE
Richard G. Hurlburt and George H. Lamb (M.S. Thesis) Jun. 1965 161 p refs
(GAW/MECH/65-28; AD-618729)

The general equations of motion are derived for a flexible vehicle spinning out of the orbital plane, under the influence of a gravity gradient. The vehicle consists of two unequal point masses connected by a flexible cable of uniformly distributed mass. The transverse and axial vibrations of the cable are assumed decoupled. A Lagrangian for continuous and discrete systems is used to derive the partial differential–integral equations of motions. A separation of variables is used to express the transverse equations of motion in terms of natural modes and normal coordinates. A method for obtaining numerical results is presented. Author

N65-35562 California Univ., Berkeley. Dept. of Mathematics.
ADIABATIC INVARIANCE. II: ELLIPTIC MOTION ABOUT A SLOWLY VARYING CENTER OF FORCE
J. E. Littlewood Jan. 1965 37 p refs
(Contract Nonr-222(60))
(AD-618745)

The present paper considers the two-dimensional motion of a unit mass acted on by a force $\omega^{-1}r^{-2}$ where ω is a slowly varying function of time. The eccentricity of the instantaneous ellipse is found to be an adiabatic invariant. There is some similarity between this result and Kruskal's consideration of a charged particle in a slowly varying magnetic field. It is shown that for suitable potential functions and slowly varying $\omega(t)$, a unit mass moving according to $\ddot{x} = -V_x(x,\omega)$ will experience a momentary periodic motion with $\oint \dot{x}\, dx$ as an adiabatic invariant. Author

N65-35606# TRG, Inc., Melville, N. Y.
FABRY-PEROT RESONANCES AT SMALL FRESNEL NUMBERS Scientific Report No. 3
Stephen R. Barone and Morris C. Newstein 3 Jan. 1965 28 p refs *Its* Rept.-160-SR-3
(Contract AF 19(604)-8817)
(AFCRL-65-174; AD-614063)

A theory of Fabry–Perot resonances designed to be useful at small Fresnel numbers is given. This theory is applied to the case where the interferometer mirrors are of arbitrary curvature and have circular apertures. Asymptotic formulas are derived for the diffraction output and phase shifts in the limit of small Fresnel numbers. These formulas demonstrate the mode discrimination properties of the interferometers when operated in this regime. Numerical results are presented covering a wider range of Fresnel numbers. Author

N65-35667# Measurement Analysis Corp., Los Angeles, Calif.
SPECTRA OF NONSTATIONARY RANDOM PROCESSES Technical Report, Mar.–Nov. 1964
Julius S. Bendat and George P. Thrall Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Mar. 1965 33 p refs
(Contract AF 33(615)-1418)
(MAC-403-03; AFFDL-TR-64-198; AD-617419)

This report defines and develops mathematical properties for three different types of spectra which can be associated with nonstationary random process: double frequency spectra, time varying spectra, and time averaged spectra. The double frequency spectra is the double Fourier transform of the nonstationary covariance function and indicates the correlation between frequencies. The time varying spectra, based upon narrow band filtering and ensemble averaging, indicates relations between frequency and time. The time averaged spectra is obtained by taking a time average of the time varying spectra. A significant measurement problem exists for the first two representations because they are two-dimensional functions, whereas the third representation is directly measurable. However, the third procedure is restricted in its applications, while the first two are suitable for general problems. Each of these spectra is computed for a particular nonstationary example, and some experimental results are shown to verify the theory. Author

N65-35720# Harry Diamond Labs., Washington, D. C.
DETERMINATION OF THE REFLECTING PROPERTIES OF PRESSED MgO POWDER
Donald Mary 5 Mar. 1965 41 p ref
(HDL-TM-65-12; AD-615158)

Blocks of pressed MgO powder have recently become available for use as diffuse reflectance standards. The calibration of one such sample in the visible portion of the spectrum is described. Specifically, the total hemispherical reflectivity was determined together with its dependence on the direction of view. Autho

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-34918# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
A VARIANT TRIPLET MODEL AND INTEGRAL CHARGE
Yasuhisa Katayama, Isao Umemura and Eiji Yamada Jul. 1965 20 p refs
(RIFP-48) CFSTI: HC $1.00/MF $0.50

A variant form of Sakata model for elementary particles is proposed. The fundamental triplet is assumed to obey para-Fermi statistics with capacity 3, and to be characterized by the three quantum numbers, the third component of isospin, the strangeness and the triplet number. It is not an eigenstate of electric and hyper charges, while it has definite expectation values for both charges, (2/3, −1/3, −1/3) and (1/3, 1/3, −2/3) respectively. The triplet state can be treated as *mixture* of three sets of sub-triplets which are ordinary fermions with an appropriate description. It is possible to assign them integral eigenvalues for electric and hyper charges. Under the restriction that the physically realizable states should be eigenstates of both charges, it is shown that most of low-lying states are the ones which are actually observed. Although the isolated existence of the triplet state is ruled out, the group theoretical arguments for the realizable states, such as the ratio of magnetic moments of baryons in U(6) symmetry, are not affected. Author

N65-34919# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
A MONTE CARLO CALCULATION OF NEUTRON PRODUCTION IN HEAVY ELEMENT TARGETS BY PROTONS IN THE RANGE 0.3–1BeV
J. C. D. Milton and J. S. Fraser Jun. 1965 11 p refs
(AECL-2259) CFSTI: HC $1.00/MF $0.50

A Monte Carlo calculation was undertaken to provide information on the total neutron yield in heavy element targets bombarded by protons in the range 0.3 to 1 BeV, on the spatial distribution of the yields and associated heat production, and the energy spectrum of the neutrons emerging from the target. The program can handle cylindrical or conical targets with either direction of taper and with arbitrary length and radius. The program is divided into two parts. Part I generates the cascade particles and subsequent evaporation neutrons, and part II follows the evaporation neutrons to the surface of the target. R.N.A.

N65-35947 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTION OF HIGH-ENERGY PROTONS IN SEMICONDUCTOR NUCLEAR-RADIATION DETECTORS. II: DIFFUSION-DRIFT DETECTORS
L. S. Brykina, V. S. Vasilev, B. M. Golovin, A. P. Landsman, B. P. Osipenko et al *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 264–268 refs (See N65-34925 23-30)

The variation of certain parameters of silicon n–i–p detectors under bombardment by protons with energies of about 650 MeV is described. Specimens were irradiated, and the proton beam intensity was $8 \cdot 10^9$ protons·cm^{-2}·sec^{-1}, the radiation doses received by the irradiated samples were determined from the activation of aluminum foil. The maximum dose received by the detectors was around $5 \cdot 10^{13}$ protons·cm^{-2}. In experiments with thin sensitive layers (W ~ 0.3 mm), pulse amplitude, back current, energy resolution, and capacitance were studied as functions of the doses received. Thick layer detectors (about 2 mm) were used to watch for changes in electrical structure under proton bombardment. Comparisons of these data with results obtained from proton bombardment on surface barrier detectors indicate that both types of instruments have approximately the same radiation stability. M.G.J.

N65-35004# European Atomic Energy Community, Brussels (Belgium).
NUMERICAL SOLUTION OF THE INTEGRAL TRANSPORT EQUATION IN APPROXIMATION TO ONE VELOCITY AND ISOTROPIC SCATTERING IN PLANE AND CYLINDRICAL SYMMETRY [RISOLUZIONE NUMERICA DELL'EQUAZIONE INTEGRALE DEL TRANSPORTO NELLA APPROSSIMAZIONE AD UNA VELOCITA' E SCATTERING ISOTROPO IN SIMMETRIA PIANA E CILINDRICA]
A. Inzaghi, B. Montagnini (Milan Univ.), and T. Pomentale 1965 111 p refs In ITALIAN; ENGLISH summary
(EUR-2410.i) CFSTI: HC $4.00/MF $0.75

This code solves the one velocity integral transport equation, under the assumption of isotropic scattering, in plane and cylindrical geometry. Homogeneous (eigenvalue) and non-homogeneous problems are considered. The difficulties which are usually encountered when one seeks to introduce the reflection boundary condition (of standard use in lattice cell calculations) in an integral formulation of the transport equation are eliminated by representing the angular density of the neutrons entering the cell from the neighboring ones by means of rapidly converging spherical harmonics expansion. Author

N65-35005# Milan Univ. (Italy).
A METHOD OF NUMERICAL SOLUTION OF THE INTEGRAL TRANSPORT EQUATION IN THE ONE VELOCITY AND ISOTROPIC SCATTERING APPROXIMATION [RISOLUZIONE NUMERICA DELL'EQUAZIONE INTEGRALE DEL TRANSPORTO NELLA APPROSSIMAZIONE A UNA VELOCITA' E SCATTERING ISOTROPO (TEORIA GENERALE)]
B. Montagnini Brussels, EURATOM, 1965 53 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-006-60-7 Ceti)
(EUR-2411.i) CFSTI: HC $3.00/MF $0.50

The general theory of a method of numerical solution of the integral transport equation, in the one velocity and isotropic scattering approximation is here developed. One-, two- and three-dimensional problems are considered. Attention is given to the reflection boundary condition (of standard use in lattices cell calculations). Such a condition is substituted, in our integral formulation, by a suitable distribution of neutron sources placed on the cell boundary, which describes the angular density of the neutrons entering the cell from the neighboring ones. This angular density is written in the form of a rapidly converging spherical harmonics expansion. Author

N65-35013# State Committee for the Utilization of Atomic Energy, Moscow (USSR). Institute of Theoretical and Experimental Physics.
THE PRINCIPLE OF CAUSALITY AND ASYMPTOTIC BEHAVIOR OF THE SCATTERING AMPLITUDE [PRINTSIP PRICHINNOSTI I ASIMPTOTICHESKOE POVEDENIE AMPLITUDY RASSEYANIYA]
N. N. Meiman 1964 18 p refs In RUSSIAN; ENGLISH summary
(NP-14346) CFSTI: HC $1.00/MF $0.50

Consideration is given to the elastic scattering reaction $p + k \rightarrow p' + k'$; where p and p' are the four-momenta of particle b before and after scattering, respectively, and k and k' are likewise for particle a. Let $A_+(s;t)$ be the reaction amplitude and $A_-(s;t)$ be the amplitude of the cross-reaction $p - k' \rightarrow p' - k$. The two auxiliary amplitudes $A_\infty^{rgt}(s;t)$ and $A_\infty^{adv}(s;t)$ are introduced such that the difference $A_+ - A_\infty^{rgt}$ tends to zero at high energy in the physical domain of the reaction, and the difference $A_- - A_\infty^{adv}$ tends to zero in the physical domain of the cross-reaction. It is proved that A_∞^{rgt} and A_∞^{adv} are analytical of S in the upper and lower half-planes, respectively, and that the growth is slower than any linear exponent at complex infinity. With that, proceeding from micro-causality, the structure of admissible distributions is obtained. Author

N65-35054# Research Inst. of National Defence, Stockholm (Sweden).
PROGRAM DESCRIPTION AND USER'S MANUAL FOR PROTOS, A COMPUTER PROGRAM FOR TREATING PROTON SLOWING-DOWN DUE TO ATOMIC COLLISIONS
C. Johansson Jul. 1965 28 p refs
(FOA-4-A-4436-411) CFSTI: HC $2.00/MF $0.50

A description of the computer program which is written in Fortran II for the IBM 7090 computer is presented. Information is given on input data preparation and on the interpretation of the output. A detailed sample problem is included. C.T.C.

N65-35142# Michigan Univ., Ann Arbor.
MANY CHANNEL RESONANCE THEORY
Marc Ross Aug. 1964 5 p Presented at the Intern. Conf. on High Energy Phys., Dubna (USSR) Prepared in Cooperation with Brookhaven Nat. Lab.
(Contract AT(11-1)-1112)
(CONF-550-96)

A simple representation of the partial wave amplitude for many coupled two body channels is discussed. A simple theory is obtained of the effects of many channels and their thresholds by representing the right hand cuts explicitly and exactly, while drastically approximating the left hand singularities. C.T.C.

N65-35148# Joint Inst. for Nuclear Research, Dubna (USSR).
AN INVESTIGATION OF NEUTRAL KAON DECAYS
M. Anikina, G. Vardenga, M. Zhurovleva, D. Kotpyarevskiy, Yu. Dukstin'sh et al 1965 13 p refs In RUSSIAN
(JINR-P-2065) CFSTI: HC $1.00/MF $0.50

One thousand eighty-two decays of K°_2 mesons detected in a magnetic cloud chamber were analyzed. The relative probability of the decay was found to be $W(K_{3\pi}) = 0.194 \pm 0.023$. The data on the lepton decay rule out the S-variant of the interaction. These data are in good agreement with the V-variant. On the basis of 267 $K_{3\pi} \rightarrow \pi + \pi - \pi^\circ$ decays an analysis was made of the distribution of the kinetic π° energy (T_0) which diverges noticeably with the phase curve (Φ). In the linear approximation: $[dW(T_0)/d\Phi] = 1 + [\alpha(T_0)/M_0]$ the value for the coefficient α was found to be $a = -8.2^{-0.9}_{+1.3}$; that is in good agreement with $|\Delta I| = 1/2$. Under the assumption about the possible existence of the 6-dipion resonance of Brown and Zinger the values for the mass and the width are obtained to be $M_6 = (350 \pm 10)$ Mev and $\Gamma_6 = (75 \pm 15)$ Mev. Author

N65-35160# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
TEMPERATURE DEPENDENT RESONANCE INTEGRALS IN UO_2 AND ThO_2
M. J. Halsall Aug. 1965 36 p refs
(CRRP-1222; AECL-2292) CFSTI: HC $2.00/MF $0.50

The multigroup, multiregion collision probability program, has been used for calculations of $^{238}UO_2$, ^{238}UC and $^{232}ThO_2$ single rod resonance integrals, and also for $^{238}UO_2$ cluster resonance integrals with various coolants. For single rods, results have been obtained for four rod sizes and three temperatures, and have been fitted to expressions of the form

$$R.I.(T) = (A + B\sqrt{S/M})\,[1 + \beta(\sqrt{T} - \sqrt{T_0})]$$

where T is the absolute temperature, S/M is the surface to mass ratio, A and B are constants, β is the Doppler coefficient and is itself a function of S/M. The results have been broken down into partial resonance integrals for use with the 9 group model. Values of A, B and power series coefficients for evaluating β are given for $^{238}UO_2$, ^{238}UC, and $^{232}ThO_2$. Author

N65-35173# Brandeis Univ., Waltham, Mass.
ON THE DERIVATION OF GENERALIZED MASTER EQUATIONS
P. M. Mathews (Madras Univ., India) [1964]. 19 p refs
(Contract Nonr-1677(04))
(AD-619182)

A derivation of the master equations for the probability and interference functions describing the time evolution of a quantum mechanical system is presented that requires no more than a trivial identity involving the diagonal part of the resolvent operator, together with a straight-forward definition for casting the equations into gain-loss form. Also presented is an alternative, less direct, derivation, which was used to elucidate the relationship between the Van Hove-Swenson formalism and that of Zwanzig; a brief outline of the latter is also given. Author

N65-35180# Institute for Mathematical Sciences, Madras (India).
LECTURES ON FERMI DYNAMICS
A. Fujii [1964] 75 p refs *Its* Matscience Rept. No. 37
(NP-15021) CFSTI: HC $3.00/MF $0.75

Kinematics related to neutron beta decay, muon decay and capture, and elastic lepton production are considered in a text of lectures dealing with Fermi dynamics. Nucleon form factors discussed include nucleon current, muon capture in hydrogen, and the hypotheses of conserved vector current and of asymptotically conserved axial vector current. A section entitled *Fermi Dynamics* deals with such topics as reflections, CP-invariance, quadlinear Fermion interaction, and beta, muon, and pion decay. An appendix considers the Dirac Equation in terms of Lorentz invariance and transformation, gamma algebra, and bilinear covariants. Other appendices cover the coupling constants in muon decay and in nucleon beta decay; and both theoretical and numerical data are included. M.W.R.

N65-35185# Argonne National Lab., Ill.
[EXPERIMENTAL NUCLEAR PHYSICS, MASS SPECTROSCOPY, THEORETICAL PHYSICS] Physics Division Summary Report, Jan.–Mar. 1964
Lowell M. Bollinger [1964] 55 p refs
(Contract W-31-109-ENG-38)
(ANL-6877)

This annotated summary covers work performed during January through March 1964. The following topics are discussed: (1) *Excited-State Spin Assignments Based on (n,γγ) Angular-Correlation Measurements on Medium-Weight Nuclei;* (2) *Radiative Capture of Neutrons;* (3) *Electron-Neutron Interaction;*—mixtures of He^3, neon, and methane were investigated; (4) *Mass-Spectrometric Studies of the Laser-Produced Graphite Jet;* (5) *S-State Interactions and Nuclear Coupling Schemes*—SU_3 model for effective nuclear interactions; and (6) *Quantum Theory of Measurement*—objections against the wash-out theory of phases. G.G.

N65-35187# Oak Ridge National Lab., Tenn.
THE ENERGY OF FORMATION OF A DOUBLE KINK AND AN EXAMINATION OF LOW-TEMPERATURE DEFORMATION
R. J. Arsenault Sep. 1965 31 p refs
(Contract W-7405-ENG-26)
(ORNL-3862) CFSTI: $2.00

The energy of formation of a double kink was calculated as a function of stress for various boundary conditions, values of elastic constants, and different dislocation lengths. The activation energy of the double kink mechanism is considered to be the formation energy of the double kink. Once a double kink has formed, the lateral motion is an athermal process. The interaction energy between the kinks and between the kinks and the remaining portions of the dislocations was found to be small compared to the formation energy of the double kink. There is fair agreement between the calculated activation energies and the experimental values. The potential energy versus displacement curve for the formation of successive double kinks was calculated for a finite dislocation. The potential energy is found to decrease to a minimum and then increase monotonically as the displacement increases. This potential energy profile is examined in terms of low-temperature internal friction and as a possible explanation of the decrease in activation volume with strain for iron deformed at low temperatures. Author

N65-35202*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POSSIBLE PROTON-ALPHA SCATTERING EXPERIMENTS AT 40 MEV
C. C. Giamati and R. M. Thaler (Case Inst. of Tech.) 20 Dec. 1963 20 p refs Submitted for Publication
(NASA-TM-X-51494) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Recently, qualitatively different phase-shift analyses of the 40 MeV proton-alpha elastic scattering and polarization data have appeared. The question arises whether further experimental data can decide in favor of one or the other of these analyses. Two classes of experiments, measurement of the triple scattering parameters R and A and measurement of the polarization P in the region of the Coulomb interference scattering cross-section minimum, have been examined to see if these provide additional information to resolve the ambiguity. We conclude that a measurement of the polarization near the Coulomb interference minimum would serve to establish on a purely experimental basis the complete scattering amplitude in the forward direction. This information would remove the ambiguity in the phase-shift analysis of this data. No further information could be gained from triple scattering experiments unless these experiments were of very high precision. Author

N65-35227*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ABSOLUTE CALIBRATION AND USE OF A SOFT X-RAY SOURCE OF CHARACTERISTIC CARBON RADIATION
Anthony J. Carmso and Werner M. Neupert Jan. 1964 30 p refs Submitted for Publication
(NASA-TM-X-51631; X-614-64-23) CFSTI: HC $2.00/MF $0.50 CSCL 20H

A measurement of the absolute photon yield of characteristic carbon K radiation produced by direct electron bombardment of a target is described. The carbon K emission is produced by a simple and economical source. The radiation is detected with a commercially available proportional counter, using both commercially available windows and thinner windows made at this laboratory. A method for determining the gas absorption efficiency of the counter and transmission of the counter window is described. The pulse height distributions obtained from the proportional counter vary in shape with target voltage indicating the presence of a bremsstrahlung

continuum as well as characteristic K radiation. The continuum contribution is subtracted from the total counting rate to obtain the photon yield of characteristic K radiation as a function of target voltage. The results of this determination are used in the calibration of a grazing incidence grating spectrometer at 44A. Author

N65-35228*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NONADIABATIC THEORY OF INELASTIC ELECTRON-HYDROGEN SCATTERING
H. L. Kyle and A. Temkin [1963] 38 p refs Submitted for Publication
(NASA-TM-X-54532) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The nonadiabatic theory is applied to the inelastic S-wave scattering of low energy electrons from atomic hydrogen. The zeroth order (angle-independent) approximation for excitation of the 2s level from the ground state is described by the same equation used to describe elastic scattering below the 2s threshold, but with more complicated boundary conditions. The solution has been effected by expanding the wave function in terms of separable solutions. With the assumption of reciprocity it is also possible to obtain the 2s-2s cross sections. The elastic (1s-1s) cross sections are within 1% of the close coupling results in the triplet case, but are about 20% greater in the singlet case. The inelastic (1s-2s) cross sections are reduced about 20% in the triplet case and 20% to 40% in the singlet case relative to the close coupling results. Author

N65-35229*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FINITE RANGE EFFECTS IN COULOMB STRIPPING
William F. Ford [1964] 6 p refs Submitted for Publication
(NASA-TM-X-51606) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Nuclear rearrangement collisions are discussed for the case of high atomic number targets and projectiles at low-bombardment energies. Previously, Morinigo developed an expression for stripping reactions under the assumption of zero-range forces. This consideration is extended to include finite-range effects in Coulomb stripping. Expressions are developed and the limitations of the equations are discussed. E.E.B.

N65-35271*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYMMETRIC EULER ANGLE DECOMPOSITION OF THE TWO-ELECTRON FIXED-NUCLEUS PROBLEM
A. K. Bhatia and A. Temkin [1964] 53 p refs Submitted for Publication
(NASA-TM-X-51505) CFSTI: HC $3.00/MF $0.50 CSCL 20H

Quantum mechanical considerations are presented for the symmetric Euler angle decomposition of the two-electron fixed-nucleus problem. The properties of angular momentum, kinetic energy, and parity are examined in detail and related to the construction of the total wave function. The general radial equations for arbitrary angular momentum for the case of two identical particles in an external field are derived and the relation between the boundary conditions for electron–atom scattering and Holmberg angles is considered. E.E.B.

N65-35273*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW ENERGY CHARGED PARTICLE DETECTION USING THE CONTINUOUS CHANNEL ELECTRON MULTIPLIER
David S. Evans May 1964 37 p refs Submitted for Publication
(NASA-TM-X-51848; X-611-64-154) CFSTI: HC $2.00/MF $0.50 CSCL 20H

It has been found to be possible to operate the continuous channel electron multiplier, a recently developed type of windowless electron multiplier, in a gain saturated mode such that single, charged particles entering the input mouth of the channel will initiate output pulses whose amplitude and shape are both uniform and independent of the character of the excitation radiation. By suitable design of the channel this saturated pulse can be made stable against changes in such operating conditions as ambient pressure and applied voltage. When operated in this mode the efficiency of the channel for the detection of electrons over the energy range 250 eV to 10 keV is estimated to be greater than 50%. Author

N65-35310*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
CORRELATION ENERGY OF TWO-ELECTRON SYSTEMS
Jean L. J. Rosenfeld and Daniel D. Konowalow 10 Jun. 1964 19 p refs
(Grant NsG-275-62; Contract AF 33(657)-7311)
(NASA-CR-56871; WIS-TCI-50) CFSTI: HC $1.00/MF $0.50 CSCL 20J

Correlated closed-shell and open-shell functions (due to Roothaan and Weiss) are analyzed in terms of a 1/Z expansion to obtain the corresponding first order wave functions and the second order energy. The need for expanding the open-shell functions in powers of $Z^{-1/2}$ is demonstrated. The contributions to the second order energy from radial and angular correlation are estimated. Author

N65-35325# Oak Ridge National Lab., Tenn.
SHIELDING OF 4.8 GeV BREMSSTRAHLUNG BY HEAVY CONCRETE
G. Bathow, E. Freytag, and K. Tesch [1964] 11 p refs Transl. into ENGLISH from a publ. of Deutsches Elektronen-Synchrotron (Hamburg)
(ORNL-TR-547)

Bremsstrahlung was produced by 4.8 GeV electrons impinging on a quantameter, and the emerging radiations and their attenuation in heavy concrete were measured. The instruments used include a tissue equivalent ionization chamber, an argon filled ionization chamber (Jordan chamber), a neutron dosimeter, and several activation foils for measuring the neutron flux. Results are given for the neutron flux and dose rates of some radiation components behind concrete shielding up to 160 cm and at angles from 0° to 125°, for the attenuation coefficients of the radiation components, and for the number of giant resonance neutrons produced. R.N.A.

N65-35333# Yale Univ., New Haven, Conn.
DIRECT EVIDENCE FOR THE ODD-EVEN L ANOMALY IN INELASTIC SCATTERING
K. R. Greider [1964] 13 p refs
(Contract AT(30-1)-1807)
(NYO-1807-10)

A diffraction model which describes the inelastic scattering of particles from a spherical target and which includes spin-orbit scattering was previously introduced. The model obtains results in good agreement with recent deuteron stripping experiments and obtains a phase rule by which the total spin of residual nuclei can be identified from the angular distribution of scattered particles. In addition, the model predicts a general

unusual behavior of large angle differential cross sections for a wide variety of inelastic spin-independent processes. This subject is explored and the unusual and unexpected result of the previous work, that for strongly absorbing inelastic interactions, theoretical differential cross sections have an anomalous oscillating structure at large angles depending on whether the angular momentum transfer is even or odd is examined in detail. E.E.B.

N65-35337*# California Univ., Berkeley. Lawrence Radiation Lab.
EXPERIMENTAL STUDY OF MULTIPARTICLE RESONANCE DECAYS
Gerson Goldhaber Jan. 1965 51 p refs Presented at the Second Conf. on Symmetry Principles at High Energy, Coral Gables, Fla., 20–22 Jan. 1965
(Contract W-7405-ENG-48)
(UCRL-11971; CONF-650106-4) CSCL 20H

The status of some resonance states giving rise to multiparticle decay are reviewed and some of the unsolved problems in particle physics are discussed. Among the many nuclear meson processes discussed were the mass enhancement observed in the three pion system; enhancement in the $\pi\omega$ system; H-meson production; $K^{\pm}\pi$ enhancements; hyperon-pion enhancement; kaon-pion resonance; kaon-kaon enhancement; and the ρ-meson. E.E.B.

N65-35339# California Inst. of Tech., Pasadena.
BEYOND SU(3)$^{+}$
Yuval Ne'eman [1965] 22 p refs Presented at the Second Conf. on Symmetry Principles at High Energy, Coral Gables, Fla., 20–22 Jan. 1965
(Contract AT(11-1)-68)
(CALT-68-31; CONF-650106-6)

Some SU(3) assignments are discussed; progress is reviewed in the understanding of SU(3) and the transformation properties of various symmetries; protosymmetry higher than SU(3) with parity is considered; chiral symmetries are discussed for the condition where the endosymmetry is extended to include parity; and Wigner type and Lorentz extensions of SU(3) are described. Assignments, octet enhancement, the Christenson phenomenological minus one riddle, spin extension, and bootstraps, and the noncompact groups are included. Meson, hyperon, baryon, and lepton representations are examined. E.E.B.

N65-35340# California U., Berkeley. Lawrence Radiation Lab.
NUCLEAR MASSES AND DEFORMATIONS
William D. Myers and Wladyslaw J. Swiatecki 27 May 1965 397 p refs
(Contract W-7405-ENG-48)
(UCRL-11980) CFSTI: $6.00

A semi-empirical theory of nuclear masses and deformations is presented. The potential energy of a nucleus, considered as a function of N, Z, and the nuclear shape, is assumed to be given by the liquid-drop model, modified by a shell correction. The resulting semi-empirical expression for the nuclear deformation energy has seven adjustable parameters, four in the liquid-drop part and three in the shell correction. By making the deformation energy stationary with respect to distortions, the equilibrium deformations (i. e., the quadrupole moments) and the ground-state masses of nuclei are derived as functions of N and Z. In addition, from unstable shapes of equilibrium corresponding to saddle-point configurations, barrier energies for nuclear fission are deduced. The predictions of the theory are compared with some 1200 experimental nuclear masses, 240 quadrupole moments, and 40 fission barriers. The results lead, on the one hand, to a re-assessment of the accuracy of the liquid-drop model and a firmer determination of its characteristic constants and, on the other, to a semi-quantitative understanding of the effects of shell structure on nuclear masses and deformations. Author

N65-35346# Texas Univ., Austin. Dept. of Physics.
THE PHYSICS OF METASTABLE SYSTEMS Final Report, Feb. 1, 1964–Jan. 31, 1965
W. W. Robertson [1965] 11 p refs
(Grant AF-AFOSR-273-64)
(AFOSR-65-1052; AD-619100)

Brief summaries are given of the results of research in the following areas: spectra excited in an argon afterglow; spectral emission of the helium afterglow; the helium afterglow (atomic spectrum, molecular spectrum); the molecular spectrum in a helium afterglow; atomic emission of the helium afterglow; spectra excited in a helium afterglow; cataphoresis in helium-neon mixtures. A cumulative list of publications, which describe the research more fully, is included. Author

N65-35364# California Inst. of Tech., Pasadena.
THE SYMMETRY BREAKING INTERACTION
Yuval Ne'eman Oct. 1964 7 p refs Presented at Am. Phys. Soc. Meeting, Argonne Natl. Lab. Symp. on Symmetries in Particle Dyn., Chicago
(Contract AT(11-1)-68)
(CAL-T-68-14) CSCL 20H

Various concepts of the bootstrap idea are discussed, and alternative interpretations are proposed. Symmetries are introduced a priori, as against the bootstrap theory of the emergence of the broken SU (3) in the strong interactions as a kinematical result. The fifth interaction is discussed, and existing data are reviewed. An approach suggested is that the chiral symmetry determines the hadron states; i.e., the symmetry obtained when the weak axial vector current is considered as partially conserved (in the limit of vanishing baryon mass). Expressions are given in support of this suggestion. M.G.J.

N65-35366# General Dynamics Corp., San Diego. General Atomic.
HEXSCAT: COHERENT ELASTIC SCATTERING OF NEUTRONS BY HEXAGONAL LATTICES
Y. D. Naliboff and J. U. Koppel 15 Dec. 1964 13 p refs
(Contract AT(04-3)-167)
(GA-6026)

The HEXSCAT computer code which calculates the P_0 and P_1 components of the polycrystalline coherent elastic neutron scattering cross section per nucleus for a hexagonal lattice, is described. Subroutines for the evaluation of $|F|^2/N$ for graphite and beryllium were written, and are listed along with the main program and an interpolation routine. Included are comparative data on calculated and measured values of $\sigma_{coh}^{Be}(E)$ and code results. S.C.W.

N65-35367# International Centre for Theoretical Physics, Trieste (Italy).
FOLDY-WOUTHUYSEN AND LORENTZ TRANSFORMATIONS
I. Saavedra (Univ. de Chile, Santiago) Apr. 1965 10 p refs
(IC/65/39) CFSTI: HC $1.00/MF $0.50

The relation between the Foldy–Wouthuysen and the Lorentz transformations is discussed and an operator is constructed that makes the Lorentz transformation unitary. The operator has the property that its inverse transforms the Dirac energy spinors into the spinors obtained from a Lorentz transformation from the electron rest frame. Using this operator it is shown that the Foldy–Wouthuysen transformation can be decomposed into the product of two transformations, one that makes the non-covariant Dirac Hamiltonian equation into the proper covariant Lorentz form and one that transforms back from this reference system to the rest system of the particle. E.E.B.

N65-35371# California Univ., Berkeley. Lawrence Radiation Lab.

REVIEW OF FILM-LESS SPARK CHAMBER TECHNIQUES: ACOUSTIC AND VIDICON

Victor Perez-Mendez 3 May 1965 12 p refs Presented at the Purdue Conf. on Instrumentation for High-Energy Phys., May 1965

(Contract W-7405-ENG-48)

(UCRL-16087; CONF-650510-3)

Presented is a review of Vidicon and acoustic techniques which have the common objective of providing direct digitized readouts for spark chambers into buffer storages or directly into computers. Discussed are proposed improvements which have increased the performance of these techniques, and a review of their future applications in high energy physics. S.C.W.

N65-35373# California Inst. of Tech., Pasadena.

TRIPLETS AND TRIALITY

Murray Gell-Mann [1964] 6 p refs Presented at the Intern. High Energy Phys. Conf., Dubna, USSR, Aug. 1964 Sponsored by AEC

(CAL-T-68-8; Conf-550-95)

The question of whether or not triplets, or spinor representations of SU (3), will show up among hadrons is briefly discussed, and the hypothetical case that real hadrons exist with $\tau = \pm 1$ is examined. It is pointed out that such a situation is compatible with a Lagrangian field theory based on a fundamental triplet, and it may also be compatible with the bootstrap hypothesis. Four physically distinct situations are enumerated, in which the essential points are the nature of the quantum number, $n_t - n_{\bar{t}}$; its relation to triality τ; and the degree of its conservation. These symmetry questions determine the readily observable properties of the hadrons with $\tau \neq 0$, if such exist. A number of Lagrangian field theory models are reviewed, and the possibility that different types of hadrons exist is explored. M.G.J.

N65-35374# Princeton Univ., N. J.

X-RAYS EMITTED IN COINCIDENCE WITH THE FISSION OF Cf^{252}

Richard A. Atneosen, T. Darrah Thomas, Walter M. Gibson, (Bell Telephone Labs.) and Morris L. Perlman (Brookhaven Natl. Lab.) 26 Jan. 1965 12 p refs Presented at the IAEA Symp. on the Phys. and Chem. of Fission, 22–26 Mar. 1965

(Contract AT(30-1)-2137)

(PPAD-2137-536; CONF-650301-14)

The results of measurements of the lifetimes of K X-rays emitted in coincidence with the fission of Cf^{252} are presented. Information on the spectrum of K X-rays and the number of K X-rays per fission is included. Also included are the results of measurements of the yield and spectrum of electrons emitted in coincidence with the fission of Cf^{252} as a function of the mass division. C.T.C.

N65-35375# European Organization for Nuclear Research, Geneva (Switzerland).

STUDIES OF INTERACTIONS OF HIGH-ENERGY NEUTRINOS IN A HEAVY-LIQUID BUBBLE CHAMBER [ETUDES D'INTERACTIONS DE NEUTRINOS DE GRANDE ENEGIE DANS UNE CHAMBRE A BULLES A LIQUIDE LOURDE]

Michel Paty 5 Apr. 1965 83 p refs In FRENCH

(CERN-65-12) CFSTI: HC $3.00/MF $0.75

An analysis of the interactions of high energy neutrinos in a heavy liquid bubble chamber is presented. Photographs of neutrino interactions in a volume of CF_3Br whose density is 1.5 are considered. Experimental methods are described, and the kinematics of neutrino interactions are discussed. The analysis includes: the study of the elastic interaction, and the determination of the axial factor of the nucleon; an investigation of the hypothetical intermediate boson, and a determination of the lower limit of its mass; a discussion of the production of pions and other elementary particles by neutrino action; the existence of two different kinds of neutrinos and various laws of conservation; and the calculation of the upper limit of the neutral leptonic current. Transl. by G.A.L.

N65-35377# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON COLLECTIVE NONROTATIONAL STATES OF ODD-MASS DEFORMED NUCLEI [O KOLLEKTIVNYKH NEROTATSIONNYKH SOSTOYAKH NECHETNYKH DEFORMIROVANNYKH YADER]

V. G. Solov'ev 1965 5 p refs In RUSSIAN Submitted for Publication

(JINR-P-2045; R-2045) CFSTI: HC $1.00/MF $0.50

The collective nonrotational states of odd-mass deformed nuclei are generally investigated. Some conclusions are drawn about the position of such states in the nuclei of rare-earth and transuranium regions. Author

N65-35378# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON SOME CASES OF CONSERVATION OF CONDITIONALLY-PERIODIC MOTIONS BY A SMALL CHANGE OF THE HAMILTONIAN FUNCTION [O NEKOTORYKH SLUCHAYAKH SOKHRANENIYA USLOVNO-PERIODICHESKIKH DVIZHENII PRI MALOM IZMENENII FUNKTSII GAMIL'TONA]

V. K. Mel'nikov 1965 6 p refs In RUSSIAN

(JINR-P-2132; R-2132) CFSTI: HC $1.00/MF $0.50

A theorem of conservation of conditionally periodic motions by a small change of the Hamiltonian function is proved for some new cases. This theorem includes, as a particular case, the Kolmogorov theorem about the conservation of conditionally periodic motions by a small change of the Hamiltonian function. Author

N65-35382# Polish Academy of Sciences, Warsaw.

CASCADE CURVES FOR XENON [KRZYWE KASKDOWE DLA KSENONU]

Zdzislaw Jablonski Jan. 1965 46 p refs

(Rept.-598/VI/PH) CFSTI: HC $2.00/MF $0.50

The calculations of the number of electrons $N_p(E_o,E^o,t)$ of the electron-photon cascade with energies greater than E^o at the depth of t cascade units initiated by a single electon or a single photon with the energy E_o were performed. In the calculations the moment method was used. Values of the energy E_o were assumed in the interval:

$$5.76 \times 10^7 \text{ eV to } 2 \times 10^{10} \text{ eV.}$$

Author

N65-35383# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON DEUTERON THRESHOLD STATES IN LIGHT NUCLEI
V. V. Balashev and I. Rotter 1965 5 p refs In RUSSIAN
(JINR-P-2079) CFSTI: HC $1.00/MF $0.50

The microstructure of deuteron states excited in the reactions (Li^6,α) by a direct deuteron transfer to the target nucleus is considered. A calculation was made of the spectra of the deuteron reduced widths in the channels $Li^6 + d \rightarrow Be^8$ and $Be^9 + d \rightarrow B^{11}$. The main maximum of the spectra has a shape of the giant resonance and lies, according to experiment, in a region close to the threshold of the deuteron disintegration of the finite nucleus. It is explained at the same time, why in the reaction Li^6 (Li^6,α) Be^8 there is a branch which corresponds to the ground and the first excited states of Be^8. Author

N65-35384# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON RADIATIVE DECAYS OF VECTOR MESONS
L. D. Solov'ev 1965 5 p refs In RUSSIAN
(JINR-P-2089) CFSTI: HC $1.00/MF $0.50

Radiative decays of vector mesons are treated in the framework of SU(3) and SU(6) symmetries. Author

N65-35389# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
PHOTOFISSION OF Bi, W, AND Ag FROM 300 TO 1000 MeV
H. G. de Carvalho, G. Cortini, E. del Guidice, G. Potenza, R. Rinzivillo et al 1964 10 p refs *Its* Notas de Fis., v. 11, no. 11 CFSTI: HC $1.00/MF $0.50

Experimental results on the fission of bismuth, tungsten, and silver induced by photons between 300 and 1000 MeV, are presented. Data on cross sections per equivalent quantum at 1000 MeV, cross sections per photon between 300 and 1000 MeV, and fissility, are included. S.C.W.

N65-35390# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
TOTAL CROSS SECTION MEASUREMENTS OF STABLE AND RADIOACTIVE ISOTOPES
G. D. Hickman [1965] 12 p Presented at the Cornell Univ. Nucl. Eng. Seminar, 12 Jan. 1965 and Am. Phys. Soc., New York, 27 Jan. 1965
(Contract W-31-109-ENG-52)
(CONF-758-2)

A program for the measurement of energy dependent thermal total cross sections of stable and radioactive isotopes is described. A slow neutron chopper-flight path system which was used in the measurements is discussed. Also, calculations of cross-section probability distributions using a model with uniformly-spaced resonance of uniform widths were performed. These calculations show that a large number of stable or long lived fission products with large cross sections cannot be expected to exist. However, it was not possible to predict with certainty the exact number or which isotopes will have large cross sections. E.E.B.

N65-35413*# New York Univ., N. Y. Dept. of Physics.
A POSTULATED LAW FOR THE MASSES OF THE ELEMENTARY PARTICLES
R. Mirman [1961] 15 p refs
(NASA-CR-67390) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The formula previously postulated for the masses of the elementary particles is stated in a revised form and shown to be in good agreement with the empirical masses. The existence of a neutral shift is shown. Implications of these facts are discussed. Possible application of the formula to resonances is considered. Author

N65-35438# Argonne National Lab., Ill.
NEUTRON RESONANCE INTEGRAL AND AGE DATA
A. E. Mc Arthy and P. J. Persiani 29 Jan. 1965 14 p refs *Its* Newsletter No. 11
(Contract W-31-109-ENG-38)
(TID-21744)

The resonance integrals for the two copper isotopes were computed in the single-level Breit-Wigner approximation using the ANL-RP/266 code. In the case of Cu^{63} the resolved levels contributed 10.80 barns and the unresolved levels contributed 0.62 barns to the integral. The reported experimental value of 377 ±34 barns for Dy^{164} agreed with the computer value of 382.16. The computed resonance integral for this isotope involved using a radiative width of 76 mV for the bound level and a width of 115 mV for the positive levels. This choice of widths allowed very good agreement between experimental and calculated capture cross section in the low energy region. The experimental value of 2595 barns for the 54 minute In^{115} isotope was consistent with the value of 2500 barns reported for the 54 minute component of the 54 minute and 14 sec isotope. The resonance integral of 82.7±1.8 barns for Th^{232} was in good agreement with the experimental value of 85 barns. The age of fission neutrons to indium resonance energy in water, zirconium–water, iron–water, non-aqueous moderator materials, and water–deuterium oxide mixtures is tabulated. E.E.B.

N65-35454# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
n-PION CONFIGURATIONAL WAVE FUNCTIONS WITH DEFINITE SYMMETRY [KONFIGURACYJNE FUNKCJE FALOWE O OKRESLONEJ SYMETRII DLA n MEZONOW π]
M. Grynberg Feb. 1965 32 p refs
(Rept.-606/VII/PH) CFSTI: HC $2.00/MF $0.50

A set of n-pion configurational wave functions which should transform under any permutation of pions according to the irreducible representations of the symmetry group S_n, and possess definite values of the grand angular momentum Λ and the total angular momentum J, is given in the case of $\Lambda < 3$. The method of construction of such functions is described. Author

N65-35461# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
NUCLEAR SPIN RELAXATION BY FIXED DAMAGE CENTERS IN IRRADIATED $NaH_3(SeO_3)_2$
R. Blinc and I. Zupancic Dec. 1964 6 p refs Submitted for Publication
(NIJS-R-444) CFSTI: HC $1.00/MF $0.50

A single crystal of $NaH_3(SeO_3)_2$ was irradiated at room temperature by Co^{60} gamma rays and the proton spin-lattice relaxation time was measured by a sequence of $\pi/2$ pulses using a broad line spin-echo spectrometer at 21.5 Mc/sec. It was found that the recovery of the nuclear magnetization after saturation can be described by a single expontential function at all temperatures and radiation doses. Up to 10 MR, the inverse of the relaxation time is a linear function of the concentration of paramagnetic damage centers. At higher doses, a tendency to saturation was found indicating a breakdown of the approximations made in the derivation of the formula for the computation of the relaxation time. Curves are given

for the room temperature proton spin-lattice relaxation time as a function of the time of irradiation and as a function of temperature. E.E.B.

N65-35469# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
THE PROBLEM OF MASS FORMULAS IN THE ISL (6) THEORY
P. Suranyi 1965 6 p refs Submitted for Publication
(JINR-E-2173) CFSTI: HC $1.00/MF $0.50

A principal difficulty is shown for the method wherein the mass operator is defined as a quadratic combination of 36 momentum operators and splitting with very attractive mass formulas is obtained. It is assumed that the meson fields are described by some representation of the ISL(6) group. Some of the components of the meson field operator describe the pseudoscalar mesons, and these components transform as an octet representation of SU(3). The pseudoscalar operators satisfy certain commutation relations; and the eigenvalues of the operators are defined. The validity of various equations is established; and the sequence of equations leads to a spontaneous breakdown of the symmetry independent of the existence of the 36 momentum operators; since the mean values of the operators will depend on the octet index of the physical particle in question, an easy mass formula does not result. If the masses of the pseudoscalar octet do not split, the same fact can be shown for the meson vectors. These considerations are not restricted to ISL(6) symmetry. M.W.R

N65-35474# Nihon Univ., Tokyo (Japan). Dept. of Physics.
ON THE EXPONENTIAL DECREASES OF THE LARGE MOMENTUM TRANSFER SCATTERING AMPLITUDES AT HIGH ENERGIES
Naohiko Masuda [1965] 15 p refs
(NUP-65-10) CFSTI: HC $1.00/MF $0.50

Assuming the analyticity, crossing symmetry and exponential boundedness of the large momentum transfer scattering amplitudes, the asymptotic relation for the differential cross sections

$$\lim_{\substack{s\to+\infty \\ u\to+\infty}} \frac{\ln \dfrac{d\sigma \bar{A}_2 B_1 \to \bar{A}_1 B_2^{(u,\,t)}}{dt}}{\ln \dfrac{d\sigma A_1 B_1 \to A_2 B_2^{(s,\,t)}}{dt}} = 1$$

is proved at high energies. A and B are particles, and s, t, and u are Mandelstam's variables; with t being fixed. L.S.

N65-35506# Warsaw Univ. (Poland). Dept. of Radiochemistry.
NEUTRINOS IN SUPERDENSE MATTER. II: MASSLESS NEUTRINOS IN PERFECT FLUID SPHERE [NEUTRINA W SUPERGESTEJ MATERII. II: NEUTRINA O MASIE ZERO W KULI CIECZY DOSKONALEJ]
Bronislaw Kuchowicz May 1965 12 p refs
(Rept.-243/65) CFSTI: HC $1.00/MF $0.50

The classical movement of massless neutrinos inside an incompressible fluid sphere is investigated. The substantial result is that for certain values of physical parameters the neutrinos do not leave the interior. Preliminary estimations show that this result may apply to neutron stars. Author

N65-35527# California Univ., Livermore. Lawrence Radiation Lab.
NEW ELEMENTS IN MENDELEYEV'S PERIODIC SYSTEM
V. I. Gol'Danskiy Apr. 1965 145 p refs Transl. into ENGLISH of "Novyye Elementy v Periodicheskoy Sisteme D. I. Mendeleyeva" Moscow, Atomizdat, 1964 280 p
(VCRL-TRANS-1218(L))

A revised edition which contains data on the artificial production and primary properties of new elements in Mendeleyev's periodic system is reported. Presented are data on: the fundamentals of atomic structure; the main characteristics of atomic nuclei and nuclear transformations; radiochemical methods and their applications; the synthesis and properties of technetium, promethium, astatine, and francium which were placed in positions 43, 61, 85, and 87 of the periodic chart; and the physical and chemical properties, methods of separation, and position of the transuranium elements (93 to 103) in the periodic table. S.C.W.

N65-35534# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
PHASE SPACE CONSIDERATIONS FOR THREE-PARTICLE AND FOUR-PARTICLE FINAL STATES
Per Nyborg, Hi Sung Song, William J. Kernan, and Roland H. Good, Jr. Jul. 1965 45 p refs
(Contract W-7405-ENG-82)
(IS-1214) CFSTI: $2.00

This report gives a detailed and explicit discussion of four-particle phase space in terms of invariant mass variables. The distribution of final states, after taking account of energy and momentum conservation, is integrated over orientations of the entire system and then expressed in terms of the squares of the invariant masses M_{12}, M_{34}, M_{14}, M_{124}, and M_{134}. The results permit analysis for two- and for three-particle resonances. Formulas are given for the boundary of the allowed region in the five dimensions and for the distribution of final states inside. The simpler distributions which result when integrations can be made over some of the invariant masses are derived. The phase space properties of a three-particle system are reviewed also since they provide a guide to the discussion of the four-particle problem. Author

N65-35540# Michigan Univ., Ann Arbor.
PERIPHERAL MODEL FOR ρ AND $\rho\pi$ PRODUCTION
Marc Ross [1964] 6 p refs Presented at the Intern. Conf. on High Energy Phys., Dubna, USSR, Aug. 1964
(Contract AT(11-1)-1112)
(Conf-550-97)

Peripheral production processes are discussed. The one pion exchange cross section for $\pi + N \to \rho + N$ taking into account the modification due to initial and final state absorption was calculated. The form factor F^2, (of the expressed $d\sigma/dt = F^2(s,t)\ d\sigma^p/dt$) which was introduced phenomenologically to bring the simple one pion exchange cross section of $d\sigma^p/dt$ into agreement with the experimental cross section, is found to be due to the absorption processes. The true form factor is of relatively little importance at small momentum transfer. The effective form factor due to the absorption process is calculated very crudely, and damping factors are considered. Also discussed are kinematical peaks which can occur in mass distributions in multiperipheral reactions (reactions in which there are four particle vertices which are themselves peripheral or have diffraction type amplitudes). L.S.

N65-35608# General Dynamics/Convair, San Diego, Calif.
INTENSITIES OF PURE ROTATIONAL BAND SYSTEMS OF SYMMETRIC TOP MOLECULES Scientific Report No. 2
William Malkmus Mar. 1965 20 p refs
(Contract AF 19(628)-4360; ARPA Order 363; Proj. Defender)
(GD/C-DBE65-002; AFCRL-65-208; AD-615408)

An exact expression for the total intensity of the pure rotational band system of a rigid symmetric top molecule is derived. An approximate expression for the mean spectral absorption coefficient is obtained and is compared with previously published results. The first-order effects of nonrigidity and mechanical anharmonicity on the band intensity are investigated in the special case of a diatomic molecule and found to be small in general. Author

N65-35669# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND NONVARIATIONAL PRINCIPLES IN ANALYTICAL DYNAMICS
Richard Bellman, Harriet Kagiwada, and Robert Kalaba Jul. 1965 15 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4591-PR; AD-617318)

The authors provide an integration theory for the canonical equations of motion with parallels to the classical theory of Jacobi. The new approach is applicable to the general case where there is no variational principle underlying the equations of motion. Author

N65-35709# General Dynamics/Fort Worth, Tex.
COLD-NEUTRON SCATTERING CROSS SECTION OF LIQUID HYDROGEN BASED ON A CONSISTENT-VIBRATIONS LIQUID MODEL Technical Report, 1 Oct. 1963–30 Sep. 1964
H. G. Carter Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1965 62 p refs
(Contract AF 29(601)-6213)
(FZK-199; WL-TR-64-161; AD-614038)

It is assumed that the molecules can be regarded as rigid rotators, the centers of mass of which execute quantized harmonic motions about central sites in a liquid quasi-lattice. A consistent-vibrations liquid model, which is presented in a collateral AFWL report, WL TR-64-162, provides the state-dependent vibration parameters and the neighbor distributions resulting from thermal disorder. The derived cross sections may be divided into diffuse and interference parts. Insofar as the molecular motion conforms to a system of independent oscillators, the inelastic scattering, which may result from rotational molecular excitation, from excitation of a quantum level of the center-of-mass motion, or from both processes simultaneously, is purely incoherent. The interference scattering is found to be independent of the relative concentrations of para- and ortho-hydrogen. Calculated para-hydrogen cross sections for various inelastic processes associated with the scattering of 0.065-ev neutrons through 90° are compared with a published experimental spectrum. For final neutron energies above 0.02 ev, the calculated results are decidedly better than those based on a perfect-gas model. Author

N65-35718# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
THE INTERACTIONS OF 14.6-MeV NEUTRONS IN IRON, LITHIUM-7, AND CARBON
G. T. Western, R. C. Baird, F. L. Gibbons, and J. R. Williams Kirtland AFB, N. Mex., AF Systems Command Mar. 1965 124 p refs
(Contract AF 29(601)-6213)
(WL-TR-64-140; FZK-210; AD-614451)

The neutron differential cross sections for inelastic scattering from Fe were measured at $\theta_{CM} = 50°$, 70°, and 115°. The neutron differential cross sections for elastic scattering from C and for inelastic scattering from the first level in C were measured at $\theta_{CM} = 47°$ and found to be 49.6 ±3.6 and 21.8 ±1.7 mb/ster, respectively. Total cross sections for Fe and C were measured as 2.49 ±0.05 and 1.30 ±0.02 barns, respectively. The energy and angular distributions of inelastically produced gamma rays from Fe and Li^7 were measured using two different types of gamma spectrometers. The differential scattering cross sections for production of the 0.845- and 1.24-Mev gamma rays and for gamma rays in the energy interval $1 < E_\gamma < 10.5$ Mev from Fe were measured for nine angles of emission. The differential cross section for inelastic scattering from the 0.477-Mev level of Li^7 was measured as 7.73 ±0.54 mb/ster at $\theta_{CM} = 90°$. The calculated energy levels for Li^7 and Fe^{56}, using the collective model, are in good agreement with experimental values. The strong-coupling approximation is shown to be valid in both nuclei. Author

N65-35737# Technical Research Group, Inc., Melville, N. Y.
THEORY OF COHERENCE FOR THE QUANTIZED ELECTROMAGNETIC FIELD Scientific Report No. 4
N. Solimene Feb. 1965 45 p refs *Its* Rept.-160-SR-4
(Contract AF 19(604)-8817)
(AFCRL-65-227; AD-614062)

A preliminary account of the quantum theory of coherence for electromagnetic radiation is presented using the method of Schwinger's variational action principle. The generating functional for the quantum expectation values of arbitrary products of field operators for the free electromagnetic field subject to any homogeneous boundary conditions is explicitly given in terms of the dyadic Green's function for the corresponding classical problem. Although thermal expectation values are generated directly by the process of functional differentiation in this formulation, it is possible to generate expectation values for any free field state by employing projection operations. In particular Glauber's coherent state expectation values may be obtained. Results for the radiation field coupled only to c-number sources may trivially be extracted from the free field formulation. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-34869# Kansas State Univ., Manhattan. Kansas Engineering Experiment Staton.
THE EFFECTS OF ELECTRICAL CONDUCTANCE OF WALL ON MAGNETOHYDRODYNAMIC CHANNEL FLOW WITH HEAT TRANSFER Special Report No. 50
Um-pah Hwang, Wilson Tripp, Ching-lai Hwang, and Liang-tseng Fan Mar. 1965 58 p refs *Its* Bull. Vol. 49, No. 3
(Grant AF-AFOSR-463-64)
(AFOSR-65-1312; AD-619101)

The purpose of the report is to present the detailed as well as critical review of some mathematical and physical aspects of the MHD flow. This review should benefit the beginning investigators in this field. First, the details of the pioneering work by Hartmann and Lazarus on the subject of channel

flow are described. The modified Hartmann flow with the electrical conductance of walls investigated by Chang and Lundgren, and by Chang and Yen are then reviewed. The effect of electrical conductance of the walls for both the thermally and hydrodynamically fully developed region was investigated very recently by Alpher, Yen and Snyder. While their treatments are reviewed generally, only Snyder's approach is presented in detail. TAB

N65-34890# Hebrew Univ., Jerusalem (Israel). Dept. of Physics.
ELECTRON DENSITY IONIZATION RATE AND APPROACH TO THERMAL EQUILIBRIUM BEHIND SHOCK WAVES BY MEANS OF MICROWAVE TECHNIQUES Final Scientific Report
W. Low Oct. 1964 27 p refs
(Contract AF 61(052)-401)
(AFOSR-65-1138; AD-619093)

Improvement in the microwave diagnostics of shock waves and details of the time dependence and shape of the microwave attenuation in shocks of air at pressures of 1 and 5 mm of Hg were investigated. Also, the peak microwave attenuation of shock waves in argon and neon was measured. Further, the effect of constrictions and taper sections on the shock speed and on the microwave attenuation was determined. Experiments with an electrical discharge shock tube, construction of a 4 mm Fabry-Perot interferometer, and the testing of a 4 mm carcinotron are described. E.E.B.

N65-34896# Michigan Univ., Ann Arbor. Dept. of Aeronautical and Astronautical Engineering.
AN INVESTIGATION OF A RADIO FREQUENCY GENERATED CYLINDRICAL PLASMA WITH ALKALI METAL INJECTION
Daniel Washington Cheatham, Jr. (Ph.D. Thesis) Wright-Patterson AFB, Ohio, AF Inst. of Technol., 1965 196 p refs
(Contract AF 33(616)-8126)
(TR-65-2; AD-618693)

The thermochemical and electrical properties of a moderate temperature cylindrical plasma column were studied. The column consisted of a mixture of a low ionization potential alkali metal and a carrier gas heated by a radio frequency field to elevated temperatures and thus partially ionized. It was the purpose of this study to produce a suitable experimental model, analyze such a plasma theoretically, and measure the properties of the laboratory plasma for comparison with theory. The effect of low ionization potential seeding on plasma properties was a primary concern as was the applicability of various diagnostic techniques to this type plasma. TAB

N65-34914# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
MHD OF A QUASINEUTRAL PLASMA WITH VANISHING INTERNAL FRICTION AND HEAT CONDUCTIVITY AND FINITE ELECTRICAL CONDUCTIVITY Scientific Report No. 24
Helmut Friedel 10 Mar. 1965 23 p refs
(Contract AF 61(052)-675)
(AFOSR-65-1314; AD-618138)

Three procedures have essentially been described for solving the general MHD basic equations (finite σ). The fundamental idea for all these iteration methods is that the full system can be partly or wholly linearized in iteration steps without losing the coupling of hydrodynamic and electrodynamic quantities. The applicability of such methods is not bound to certain values of conductivity nor, more in general, to certain ranges of dimensionless parameters. Author

N65-34921# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).
DEVELOPMENT OF A METHOD FOR STUDYING NON-LINEAR PHENOMENA IN PLASMA [MISE AU POINT D'UNE METHODE D'ETUDE DES PHENOMENES NON LINEAIRES DANS UN PLASMA]
Alain Gonfalone Brussels, EURATOM, May 1965 96 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-007-62-1 FUAF)
(CEA-R-2758; EUR-2277.f) CFSTI: HC $3.00/MF $0.75

An electromagnetic wave provided by a 1 watt klystron interacts with an HF discharge (25 MHz) in the volume of a TE_{111} cavity. The tube containing the discharge and the axis of the cylindrical cavity are co-linear with a magnetic field which can attain a value such that the wave frequency is equal to the gyromagnetic frequency of the electrons. The resonance curve for the cavity, which depends on the electronic density and the frequency of collisions, becomes increasingly dissymmetric as the absorbed power increases and as the gyromagnetic frequency of the electrons approaches that of the incident wave. By studying the resonance, it is possible to calculate the proportionality coefficients relating the density and collision frequency variations with the absorbed power. The experiments were carried out by causing the following to vary separately: the incident UHF power, the initial electronic density, the pressure of the neutral ambient gas, and the axial magnetic field. The variation in the electronic density as a function of the magnetic field for a high UHF power shows a resonance of dissymetrical form, sometimes with a sharp peak in the neighborhood of W_H. The possibility of applying these properties to the construction of practical devices is under consideration. Author

N65-35015# Los Alamos Scientific Lab., N. Mex.
A MEASUREMENT OF THE ELECTRON DENSITY OF THE DENSE PLASMA FOCUS BY SCHLIEREN PHOTOGRAPHY
J. W. Mather 13 Aug. 1965 11 p
(Contract W-7405-ENG-36)
(LA-3334-MS) CFSTI: $1.00

The Schlieren method employing a pinhole aperture is used to determine the electron density of a dense plasma. An expression is derived for the mean angular divergence $<\theta>$ of a parallel light beam in terms of the refractive index, the gradient of refractivity, and the boundary shape factor of the plasma. This calculation is applied to the dense plasma focus experiment for a specific electron density distribution and plasma shape. The Schlieren method gives a least value of 10^{19} /cc, in good agreement with other independent measurements (2×10^{19}/cc). Author

N65-35031# Oak Ridge National Lab., Tenn.
THERMONUCLEAR DIVISION SEMIANNUAL PROGRESS REPORT, PERIOD ENDING APRIL 30, 1965
Sep. 1965 148 p refs
(Contract W-7405-ENG-26)
(ORNL-3836) CFSTI: $5.00

Investigations continued on microinstability losses from the DCX-1 plasma. In DCX-2 plasma studies, both hydrogen and lithium arcs, and the background gas and cold plasma were used to dissociate the molecular hydrogen ion beam. A 20 kev neutral hydrogen beam is being injected into an electron-cyclotron plasma in the EPA facility, but because of difficulties

arising from the magnetic field gradient, the magnetic field coils are being replaced. Studies are continuing using the beam plasma interaction to highly ionize a dense cloud of gas contained in a magnetic mirror machine. The population and existence of highly excited states of H_2 formed from electron capture of H_2^+ in hydrogen gas were determined. Studies continued on the 100 kv test stand for the production of intense hydrogen ion beams in the energy range 20 to 100 kev. Prospects for stable plasma confinement by magnetic mirrors are encouraging. Experiments were conducted on the B_{min} geometry applied to the magnetohydrodynamic stability of gas plasmas. Consideration of fuel-cycle chemistry in tritium burning controlled fusion devices included recognition of possible intolerably large inventory levels. R.N.A.

N65-35059*# National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.
MODULATION AND SAMPLING OF HYDROMAGNETIC RADIATION
Charles P. Sonett Washington, NASA, Oct. 1965 76 p refs
(NASA-TN-D-2950) CFSTI: HC $3.00/MF $0.75 CSCL 20I

It is shown that the detection of electromagnetic signals in the hydromagnetic domain by means of magnetometers is a low frequency extension of the electromagnetic spectrum; therefore conventional modulation theory is employable, subject to the special constraint that the carrier frequency is determined by spacecraft motions. In the presence of a hydromagnetic continuum, spacecraft spin modulation folds the spectrum so that fictitious offsets, ambient field errors, and the generation of spurious wave signals can occur, the latter from single sidebanding. Synchronous demodulation, by means of time quadrature detectors can be employed to remove such effects. Commutated telemetry which time shares experiments is shown to yield a multirate sampled spectrum. Thus telemetry can cause uncorrectable spectral folding of many orders because it generates a complex switching spectrum containing a subsidiary multiplet structure about each of the principal switching tones. Author

N65-35075# Army Electronics Labs., Fort Monmouth, N. J.
HIGH DENSITY PLASMAS Status Report
John E. Creedon Jul. 1965 14 p refs
(ECOM-2603; AD-619370)

The resistivity of high-density plasmas for use in high-current switches is being studied. This report concerns the plasma drop and its dependence on current. Data obtained from tests conducted on two diodes at peak current ranges from approximately 12,500 to 75,000 amperes at hydrogen gas pressure of 0.5, 1.0, and 5.0 millimeters are discussed. Author

N65-35115*# General Dynamics/Convair, San Diego, Calif.
STUDY OF ELECTRODE PHENOMENA IN HIGH ENERGY DENSITY DISCHARGES AS APPLIED TO PLASMA ACCELERATION PROBLEMS Second Quarterly Progress Report
Helmut Poppa 10 Aug. 1965 28 p refs
(Contract NASw-1103)
(NASA-CR-67274) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Efforts were concentrated on the investigation of structural damage in well defined noble metal target structures due to low energy argon ion bombardment. A mechanism of preferred nucleation of argon interstitials at lattice imperfections was discovered which is thought responsible for the disintegration of target structures in preferred areas. It is conceivable that the same mechanism contributes to the known small differences in sputtering yields of materials of varying degrees of crystallographic perfection for ion energies below 500 eV. This effect is not important for high ion energies in conjunction with the destruction of metal surfaces by sputtering attack since the influence of crystallographic orientation is much larger. First electron microscopy replica studies of copper cathode and anode electrodes of a coaxial plasma gun showed only minor morphological surface damage after short exposures to a nitrogen discharge. Indications are that chemical surface attack, which cannot be investigated properly by replica techniques, is predominant. Author

N65-35124*# AVCO-Everett Research Lab., Everett, Mass.
THE DIOCOTRON INSTABILITY IN A CYLINDRICAL GEOMETRY
R. H. Levy Dec. 1964 21 p refs
(Contracts NASw-1101; AF 49(638)-659)
(NASA-CR-67292; AVCO-Everett-Res. Rept.-202) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The diocotron (or slipping stream) instability of low density ($\omega_p << \omega_c$) electron beams in crossed fields is considered for a cylindrical geometry. For a simple density distribution, the normal modes of the electron beam correspond to a continuum of eigenvalues, plus two discrete eigenvalues. Work due to Case and Dikii appears to show that the continuous spectrum is not important in stability studies of this type. The condition for stability considering the discrete modes only is derived; under suitable geometrical and electrical conditions, it is shown that these modes can be stable. The analogy between the electromagnetic problem considered here and the problem of the stability of an ideal rotating fluid is discussed. It is shown that stability conditions derived for the latter problem depend on the possibility of axial perturbations; what this implies for the electron beam problem is briefly discussed. Author

N65-35129* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion
INVESTIGATION OF Na-K SEEDED ARGON PLASMA
Hsuan Yeh, Chad F. Gottschlich, and T. K. Chu *In its* [Res. in Mater., Plasma and Electrochem. Eng.] 1 Jul. 1965 7 p
(See N65-35125 23-34) CFSTI: HC $3.00/MF $0.75

A technique to measure nonequilibrium ionization and its effect in an alkali metal (Na-K) seeded argon plasma, where the nonequilibrium ionization was produced by an externally applied electric field is presented. Efforts were concentrated on completing the experimental system, overcoming material problems, and testing the methods for data collection. A fume scrubbing system was built to clean the sodium-potassium exhaust discharged from the test section which eliminated the visible emission of fumes for concentrations of sodium-potassium up to 0.5% (by weight) at an argon flow of 7 gms/sec. A purification system was constructed to eliminate the water vapor and oxygen in the argon gas. A schematic diagram of the optical arrangement with a block diagram of the associated electronic apparatus was shown. A helium discharge tube was used as a light source for testing the instruments. R.W.H.

N65-35130* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
EMITTER SURFACE PHYSICS OF PLASMA DIODES
Leon W. Zelby, George L. Schrenk, and M. Kaplit *In its* [Res. in Mater., Plasma and Electrochem. Eng.] 1 Jul. 1965 6 p refs (See N65-35125 23-34) CFSTI: HC $3.00/MF $0.75

Research to obtain a microscopic understanding of the limitations of the semi-classical phenomenological model of the emitter surface of a thermionic energy converter is presented. Two cases of considerable interest to thermionic energy conversion were studied: the adsorption of a monolayer of cesium on the surface of tungsten and the adsorption of half a monolayer of barium on the same clean tungsten surface. For both cases the surface charge did not extend far beyond the adsorbate particles, a result which is consistent with the classical concepts of adsorption. It was found that the electron–electron, and electron–nuclear interaction energies were larger than the quantum mechanical kinetic and exchange energies. R.W.H.

N65-35131* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF A ROTATING PLASMA IN A CROSSED ELECTRIC AND MAGNETIC FIELD

M. Altman, M. A. Brull, and P. Hsueh *In its* [Res. in Mater., Plasma and Electrochem. Eng.] 1 Jul. 1965 12 p refs (See N65-35125 23-34) CFSTI: HC $3.00/MF $0.75

A collection of theoretical and experimental problems were isolated which required further work to exploit their possibilities in practical devices such as plasma accelerators, MHD power generators, and ion centrifuges. The proposed research is concerned with a plasma which is contained in a vessel bounded by coaxial cylindrical electrodes and insulated bases. A crossed field was applied to the plasma by an electric field in a radial direction, and an axial magnetic field. R.W.H.

N65-35132* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.

TRANSIENT CONCENTRATION POLARIZATION IN NATURAL CONVECTION ELECTROLYSIS

Leonard Nanis and Akin Adubi Fa *In its* [Res. in Mater., Plasma and Electrochem. Eng.] 1 Jul. 1965 8 p refs (See N65-35125 23-34) CFSTI: HC $3.00/MF $0.75

Work is currently in progress to validate conclusions obtained using vertical silver anodes dissolving into various concentrations of silver nitrate. This electrode-electrolyte system was chosen because of the very large exchange current density, thus avoiding problems associated with the existence of activation overvoltage. Primary variables will be the vertical position on the electrode and the current density. Literature values for the density and viscosity of silver nitrate solutions will be used for the calculation of the expected boundary layer thickness. A program was written for machine computation of tables of the general term for equations in order to speed the analysis of the overvoltage vs time traces for δ evaluation. R.W.H.

N65-35181# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.

SOME PLASMA EFFECTS IN InSb, A TALK

Betsy Ancker-Johnson Jun. 1965 42 p refs Presented at Am. Phys. Soc., New York and NSF Plasma Dyn. Conf., Troy, N. Y., 1965

(DI-82-0452)

Presented is a survey of experiments on the following eight aspects of nonequilibrium electron-hole plasmas in InSb: impact ionization, injection, pinch effect, helical instability, giant oscillations, microwave emission, lifetime, and confinement. The difficulties of forming theoretical evaluations for these parameters are pointed out. G.G.

N65-35269*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MAGNETOHYDRODYNAMIC SHOCK STRUCTURE IN A MOVING MAGNETIC FIELD

David B. Beard (California Univ., Davis) Jun. 1964 24 p refs Submitted for Publication

(NASA-TM-X-51860; X-640-64-164) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The shock structure around a cylinder immersed in a cold collisionless plasma stream containing a weak magnetic field has been investigated in two dimensions. The stream pressure on the boundary of the sheath is proportional to $\cos^2\Psi$ where Ψ is the angle between the stream velocity and the normal to the sheath. The thickness of the sheath and particle density in the sheath on the upstream side of the cylinder have been found to be nearly constant. A tear drop shaped vacuum is formed downstream from the cylinder. The plasma electrons have essentially all the ion stream kinetic energy in the transition sheath upstream of the cylinder but the ion stream energy is regained downstream from the cylinder. The importance of this shock structure when applied to the earth's magnetosphere and the generation of Type I comet tails is discussed briefly. Author

N65-35288*# New York Univ., N. Y. Dept. of Physics.

ENERGY LOSS OF CHARGED PARTICLES IN PLASMAS Status Report, 1 Jan.–30 Jun. 1964

Werner Brandt [1964] 6 p refs

(Grant NsG-169-61)

(NASA-CR-58470) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Studies on the response of an atom to an external field continued, and the results obtained are summarized. It was also reported that a comprehensive formula for the polarizability of atoms was derived, with the coupling between single-particle excitations in the correspondence limit taken into account; the dipole photoabsorption cross section was also derived. It is felt that with these results, the theory of atomic excitations for the statistical model of the atom can be formulated. Approaches to this problem are also discussed. M.G.J.

N65-35290# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.

PLASMA PRODUCTION BY KINETIC IMPACT

S. J. Lukasik and B. J. Pernick Feb. 1965 220 p refs

(Contract DA-30-069-ORD-3467)

(R-850; AD-616636)

High speed photographic and time-resolved spectrographic observations were made of the head-on collision of two hypervelocity copper jets formed from metal-lined explosive charges. Streak camera records show that the jets are moving at about 8 mm/μsec, or with a kinetic energy of 21 ev/atom. Framing camera observations of the collision in air and in a low pressure helium atmosphere indicate that a region of intense luminosity is created about the impact point. Time-integrated spectrograph records show that the composition of the collision light over the visible region is that of a continuum with superposed copper spectral lines. Neutral copper atom density, copper ion densities, and oscillator strengths for two neutral copper transitions observed in the time-resolved spectrum are also determined. Conclusions derived from existing theoretical models of hypervelocity impact are found in good agreement with the observations and detailed measurements obtained from these experiments. Author

N65-35395*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TWO-STREAM INSTABILITY IN GRAVITATING PLASMAS WITH MAGNETIC FIELD AND ROTATION

S. P. Talwar Washington, NASA, Oct. 1965 18 p refs
(NASA-TN-D-3052) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The problem of instability in contrastreaming streams of plasma or self-gravitating gas clouds is investigated for general propagation direction, using moment equations. A uniform rotation is also included in view of its astrophysical importance. Conditions for instability (monotonic or growing wave) are derived. It is found that the classical Jeans wavelength for fragmentation of interstellar medium is considerably diminished due to interstreaming speeds. For a non-gravitating plasma it is concluded that perturbations propagating normal to the interstreaming direction lead to a monotonic instability. Though characterized by a small growth rate, it should be possible to observe this instability in laboratory plasmas if dimensions are suitably chosen to eliminate the conventional electrostatic two-stream instability. Author

N65-35398# Cekmece Nuclear Research Center, Istanbul (Turkey).

PRE-KINETIC EQUATIONS FOR A PLASMA

Ercüment Ozizmir and Kaya Imre Aug. 1965 34 p refs
(CNAEM-26) CFSTI: HC $2.00/MF $0.50

Bogoliubov theory for a multi-component plasma is generalized through relaxation of his assumptions regarding the functional dependence and the "initial condition" to obtain a theory within which the approach to the kinetic regime can be studied. It is assumed that the correlations $G/(l > s)$ are functionals of $G_1,...G_s$ and $e^{\tau\gamma}G/(e^{-\tau\gamma}G_1,...e^{-\tau\gamma}G_s) \rightarrow 0$ as $\tau \rightarrow \infty$ where γ is the Poisson bracket operator corresponding to the kinetic energy and $s(\geq 1)$ is a fixed but otherwise arbitrary integer. It is shown that the analytic solution of the resulting functional chain with respect to the parameters $\alpha = n\lambda^{1/s}$, $\beta = \lambda^{1/s}$ (where n is the density, and λ is the interaction strength) is of order β^{l-s} provided $G_1,... G_s$ are of order β^0. This property enables one to break the hierarchy in the expansion with respect to β, only. The case $s = 2$ which leads to the "pre-kinetic" equations is considered in some detail. The closed coupled set of equations for G_1 and G_2 obtained in this case differ from those studied in the literature through appearance of the double pair correlations in the equation for G_2 which makes the latter equation non-linear. Author

N65-35448# California Univ., Livermore. Lawrence Radiation Lab.

NOTE ON ELECTROSTATIC INSTABILITIES IN A PLASMA WITH ANISOTROPIC VELOCITY DISTRIBUTION

Yaakov Shima (Oak Ridge Natl. Lab.) and Laurence Hall 4 Aug. 1964 7 p refs
(Contract W-7405-ENG-48)
(UCRL-12052)

Consideration is given to delimiting the location of possibly unstable roots to the dispersion equation for electrostatic waves in an infinite plasma of a constant magnetic field. Previously developed theorems are extended to show when marginally unstable solutions can occur, and a proof is evolved. Proof is given for a bi-Maxwellian distribution of particle velocities, but the conditions considered also hold when the distribution of parallel velocities is Lorentzian. M.W.R.

N65-35451*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

REDUCTION OF FREE ELECTRON CONCENTRATION IN A REENTRY PLASMA BY INJECTION OF LIQUIDS

John S. Evans [1965] 22 p refs Presented at the 3d Symp. on the Plasma Sheath, Boston, 21–23 Sep. 1965
(NASA-TM-X-56815) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Theoretical calculations are described for the reduction in electron concentration as a function of three parameters of interest for practical applications. These are the drop size, the mass injection rate, and the time required for the drops to flow from the injection point to the antenna. The results of the calculations indicate that the addition of liquid droplets to a flowing plasma is capable of producing large reductions in electron concentration. However, it should be noted that the details of drop formation, mixing, acceleration, and evaporation were greatly simplified in the analysis. Since these processes can have important effects on the results and since the theoretical treatment of such complex phenomena is both difficult and uncertain, it appears that experimental validation of the theory is needed before conclusions can be reached about the applicability of the results. Author

N65-35452# Royal Aircraft Establishment, Farnborough (England).

PLASMA FLOWS IN INTERPLANETARY SPACE [PLASMASTROMUNGEN IN INTERPLANETAREN RAUM]

R. Lust Jul. 1965 14 p Transl. into ENGLISH from a Rept. from Max-Planck Inst. fur Phys-und Astrophys., Munich
(RAE-LIB-TRANS-1118) CFSTI: HC $1.00/MF $0.50

Various flow phenomena connected with the solar wind are surveyed. These include turbulent motions in the sun's surface and the sound waves generated aerodynamically by these; the formation of shock waves and the resulting increase of temperature which causes a continuous stream of particles away from the sun; the acceleration of these particles in the prevailing pressure field, leading to the establishment of the solar wind at supersonic speeds; and the interaction of the solar wind with the magnetosphere of the earth, leading to the formation of a shock wave, which stands off as on a blunt body, and to a wake. Some experiments involving artificial ion clouds are also discussed. Author

N65-35556# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME QUESTIONS OF THE KINETICS OF CHEMICAL REACTIONS IN PLASMA JETS

L. S. Polak and Yu. L. Khant 29 Jul. 1965 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk (Moscow), v. 156, 1964 p 920–923
(FTD-TT-65-541/1+4; AD-619321)

A computation for the quenching rate of a hot plasma jet in a cylindrical tube is presented. The equation of heat transfer with negative sources of heat was used to evaluate the temperature drop in the gas and volumetric densities of the heat discharges were found with statistical physical and kinetic values. The obtained formulas gave evaluations for the lower limits of speed and cooling. It was found that plasma jet reactions take only place in a very small section of the tube. G.G.

N65-35576*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

A MAGNETOGASDYNAMIC POWER GENERATION STUDY
Third Quarterly Progress Report

Arthur Sherman, Fredrick H. Shair, and John M. Smith 30 Jun. 1965 22 p
(Contract NAS3-6260)
(NASA-CR-67370) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Calculations were carried out on a preionized plasma in a flowing system with finite recombination rates and compared to experimental results obtained with the electron beam. Correlation between theory and experiment was excellent. As well, experiments were conducted with an applied voltage on one pair of the generator electrodes with a flowing system. Voltage-current traces were obtained when the applied electric field was either aided or opposed by a U × B induced electric field. Some estimates of sheath voltages were obtained, and the characteristics of the body of the ionized plasma could be estimated. A supersonic nozzle and test section were designed, fabricated, and commissioned. Full details will be presented in the summary report. A review of the concept of an MHD generator coupled to a space power system has been made. Abrief resume of this has been included. Author

N65-35615# Minnesota Univ., Minneapolis.
THEORETICAL RESEARCH ON THE DYNAMICS OF PLASMA RINGS Final Report, 15 Feb. 1961–19 Aug. 1964
T. S. Lundgren and C. W. Chu Wright-Patterson AFB, Ohio. ARL Jan. 1965 11 p refs
(Contract AF 33(616)-7877)
(ARL-65-12; AD-615460)

This is a summary of a group of five related papers. They are each concerned with some aspects of the large-scale motion of a current-carrying filament of plasma under the action of external and self-magnetic fields. Author

N65-35651# Illinois Univ., Urbana. Dept. of Electrical Engineering.
THE HELICAL INSTABILITY PRODUCED IN GASEOUS MAGNETOPLASMAS BY THE GYRO-INTERACTION OF MICROWAVES Scientific Report No. 1
B. E. Cherrington and L. Goldstein Jun. 1965 182 p refs
(Contract AF 19(628)-2391)
(AFCRL-65-257; AD-617696)

The nonuniform absorption of gyro-resonant microwave energy by an electron gas is used to produce the helical instability in gaseous magnetoplasmas. This helical instability is examined both theoretically and experimentally. Stability criteria for the existence of the helix and the dependence of the properties of the helix on the plasma parameters are derived from the two-fluid magnetohydrodynamic equations for electrons and ions. The experimental examination of the instability is accomplished by the development of a suitable diagnostic procedure using low power (~50 microwatt), nonresonant microwave sensing signals. The detailed examination of the properties of the helical instability verifies the theoretical predictions. Where it has been possible to measure the properties of the plasma discharge exactly, such as helix rotational frequency and discharge tube radius, excellent quantitative agreement between theory and experiment is found. Where it has only been to estimate the plasma parameters, such as electron temperature and longitudinal gradients, good qualitative agreement between theory and experiment is found. Author

N65-35759# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE DETERMINATION OF SPATIALLY NON-UNIFORM ELECTRON DENSITY DISTRIBUTION
Kurt A. Graf Apr. 1965 129 p refs
(Grants AF-AFOSR-366-63; AF-AFOSR-366-64)
(UTIAS-108; AFOSR-65-0935; AD-616614)

Electron densities have been measured in the subsonic portion of a free-expansion argon jet by microwave and Langmuir probe methods. The electron density in the jet had a Gaussian radial distribution; along the axis of the jet the density fell off approximately exponentially. Microwave measurements were made by traversing the microwave beam across the jet. This allowed the spatial variation of electron density to be determined. The data were analysed with a ray-tracing technique. Langmuir probe measurements were made with cylindrical and flat probes under essentially collision free conditions and over a range of probe radius to Debye length ratios of about 10 to 50. Both electron and ion collection were measured and analysed. The electron-current part of the characteristic has, in the past, been interpreted in two different ways. These are the so-called deviation-from-linearity method, and the two-tangent-intercept method. For a probe in free-molecular flow, electron densities determined by these methods (for the type of plasma under consideration and ideal probe characteristics) should not differ by more than about 30 percent. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-34787 Joint Publications Research Service, Washington, D. C.
SPECTROSCOPY OF ACTIVATED LASER CRYSTALS (PART III)
P. Gorlich, H. Karras, G. Kotitz, R. Lehman, and W. Ludke *In its* Spectry. and Metrotechnol. in Czechoslovakia 16 Sep. 1965 p 1–18 refs (See N65-34786 23-34) CFSTI: $2.00

The present state-of-the-art of semiconductor lasers is discussed. Doping of semiconductor crystals is compared with the activation of optically pumped lasers. In both cases, lattice spaces are occupied by suitable impurity ions substituted isomorphously for lattice-characteristic ions. However, semiconductor emission depends primarily on the crystal and less on the embedded substituents; inverse occupation is accomlished through p-n transition by means of a current flow through the transition layer. Reviewed are the laser properties of various elements, experimental laser arrangements, model concepts, special emission properties, instrumentation aspects, low temperature environments and crystal growing. G.G.

N65-34881# Perkin-Elmer Corp., Norwalk, Conn.
EVALUATION OF CERIUM OXIDE AS A LASER HOST Third Quarterly Report, 1 Nov. 1964–31 Oct. 1965
Robert C. Linares [1965] 7 p
(Contract Nonr-4660(00); ARPA Order 306-62)
(AD-619197)

During the third quarter, investigation of the properties and crystal growth of ThO_2 was begun. Some work continued on attempts to grow large crystals of CeO_2 by slow cooling of the flux and by the gradient technique. Author

N65-34891# Delaware Univ., Newark. Dept. of Physics.
ELECTRO-OPTICAL METHOD FOR INVESTIGATION OF FIELD AND CURRENT DISTRIBUTIONS IN SEMICONDUCTORS AND LAYER-LIKE FIELD DISTRIBUTIONS IN PHOTOCONDUCTORS Status Report No. 5, 1 Apr.–30 Jul. 1965

K. W. Boer [1965] 5 p refs
(Contract Nonr-4336(00))
(AD-619190)

Activities involving the following are discussed: (1) study of CdS single crystal growth; (2) investigations of electrode properties; (3) theoretical and experimental studies of field instabilities in dielectrics with negative differential resistance; and (4) evaporation and recrystallization of CdS layers as a method to produce CdS of desired electrical properties in a more reproducible way than by sublimation. R.R.D.

N65-34906*# Research Triangle Inst., Durham, N. C.
STUDY ON THE ELECTRON IRRADIATION EFFECTS ON CAPACITOR-TYPE MICROMETEOROID DETECTORS
L. K. Monteith Washington, NASA, Oct. 1965 98 p refs
(Contract NAS1-3892)
(NASA-CR-312) CFSTI: HC $3.00/MF $0.75 CSCL 20L

Electron irradiation effects of a capacitor type micrometeoroid detector were investigated to determine the charge storage in the dielectric region of the capacitor structure and the spontaneous discharge resulting from electron irradiation. Electron irradiation of capacitor structures consisting of polyethylene terephthalate films with thin aluminum electrodes results in a trapped charge distribution in the dielectric region. The decay of the trapped irradiation electrons was detected and shown to be consistent with a no-retrapping release model based on a density of traps uniform with respect to energy measured from the conduction band. A minimum value of 1.7×10^{16} per cm^3 per ev was determined for the trap density. A saturation effect for irradiation electron trapping was noted. Based on the model describing the observations, a value of 4.25×10^{15} electrons per cm^3 resulting in a maximum value of built-in electric field of 5×10^5 volts per cm was inferred. The trapped charge causing the built-in field decays to 1/2 the initial value after ceasing the irradiation in about 48 sec. A beta source irradiation of the capacitor structure resulted in spontaneous discharge. The breakdown initiated by the electric field resulting from the trapping of irradiation electrons occurs at defects in the polyethylene terephthalate film and in most cases does not liberate all the trapped charge. R.N.A.

N65-35012# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
MAGNETIC PROPERTIES OF KRAMERS RARE EARTH IONS IN ALUMINUM AND GALLIUM GARNETS [PROPRIETES MAGNETIQUES DES IONS DE KRAMERS DES TERRES RARES DANS LES GRENATS DE TERRES RARES ET D'ALUMINIUM ET LES GRENATS DE TERRES RARES ET DE GALLIUM]
Hans W. Capel Dec. 1964 96 p refs In FRENCH; ENGLISH summary
(CEA-R-2705) CFSTI: HC $3.00/MF $0.75

The magnetic properties of Kramers rare earth ions in aluminum and gallium garnets (MAlG and MGaG) are discussed by means of a molecular field treatment. The symmetry properties of the space group permit to establish a parametrization for the magnetic dipolar and exchange couplings. The magnetic properties of the system can be expressed in terms of these parameters and the g factors of the rare earth ions. We have calculated the transition temperatures, the sub-lattice magnetizations, the susceptibility in the paramagnetic region and the antiferromagnetic susceptibility for a special type of magnetic ordering. The influence of the excited Kramers doublets is described by means of a generalization of the usual g tensor. Author

N65-35090# Massachusetts Inst. of Tech., Cambridge. Materials Theory Group.
THE WAVEVECTOR DEPENDENT SPIN SUSCEPTIBILITY OF AN INTERACTING ELECTRON GAS
Donald R. Hamann (Ph.D. Thesis) 14 May 1965 112 p refs
(Contract Nonr-1841(72))
(TR-2; AD-619290)

The wave vector dependent spin susceptibility of an electron gas, which is relevant to the stability of the paramagnetic state and to indirect exchange effects was studied. The theory of the susceptibility is derived in the linearized Hartree–Fock approximation, and this simple theory is used to investigate the susceptibility of a Fermion system with statically screened interactions for a wide range of screening lengths and densities. An effective Hamiltonian formulation is derived to deal with the dynamic screening effects of electron correlations. The self-energy of the dressed electron states described by this Hamiltonian is evaluated in the vicinity of the Fermi surface. The theory of the susceptibility including correlation effects is derived, and the susceptibility functions are calculated for the electron gas at a number of densities in the metallic region and one in the high density region. It is found that the electron correlations remove the instability of the paramagnetic state relative to infinitesimal antiferromagnetic deformations found by Overhauser in the Hartree–Fock approximation. Author

N65-35095# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Physics.
THE MAGNETIC AND THERMAL PROPERTIES OF $[Cr_3(CH_3COO)_6(OH)_2]Cl\cdot 8H_2O$, A SYSTEM OF CLUSTERS OF THREE Cr^{+++} IONS
Norikiyo Uryu and S. A. Friedberg 1 Jul. 1965 66 p refs Submitted for Publication
(Contract Nonr-760(26))
(TR-1; AD-466667)

The paramagnetic susceptibility and magnetic specific heat of the complex salt $[Cr_3(CH_3COO)_6(OH)_2]Cl\cdot 8H_2O$ are examined theoretically in the light of recently obtained knowledge of its crystal structure. Each unit cell contains four isolated triangular clusters of three Cr^{+++} ions. The crystal properties may be calculated from the Hamiltonian of a single cluster. In an attempt to construct possible alternatives to Kambe's theory which requires cluster distortion, the energy levels of a cluster have been calculated assuming equal isotropic exchange interaction, $J_o[\underline{S}_1 \cdot \underline{S}_2) + (\underline{S}_2 \cdot \underline{S}_3) + (\underline{S}_3 \cdot \underline{S}_1)]$ among the Cr^{+++} ions ($\underline{S} = 3/2$) each of which experiences an axial crystalline field. In order to split the two Kramers doublets comprising the ground state as required by experiment and retain the cluster symmetry a higher order spin interaction is required of the form $J'[(\underline{S}_1 \cdot \underline{S}_2)\ (\underline{S}_2 \cdot \underline{S}_3) + (\underline{S}_2 \cdot \underline{S}_3)\ (\underline{S}_3 \cdot \underline{S}_1) + (\underline{S}_3 \cdot \underline{S}_1)\ (\underline{S}_1 \cdot \underline{S}_2)]$. Fitting the low temperature specific heat and susceptibility one finds $J_o = 30k$ and $J' = 0.9k$, with a slightly smaller value of J' required to fit the susceptibility at higher temperatures. The plausibility of such a novel interaction is considered as is the ordered spin arrangement within a cluster at low temperatures. Author

N65-35123*# Martin Co., Baltimore, Md. RIAS Div.
STUDY OF ELECTRON-PHONON INTERACTIONS IN III-V SEMICONDUCTORS Quarterly Progress Report No. 1, 15 Jan.–15 Apr. 1965
Joseph Martin and Chao Y. Huang 28 Apr. 1965 34 p refs
(Contract NAS8-20012)
(NASA-CR-67294) CFSTI: HC $2.00/MF $0.50 CSCL 20

The electron-phonon interaction is being investigated in semiconductor crystal groups III through V to determine the

various sources of attenuation and under what conditions amplification is possible. Experimental efforts to obtain attenuation measurements in indium antimonide single crystals at both 10 kmc and 10 mc frequencies are discussed. R.N.A.

N65-35141# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
MINIATURE NEUTRON DETECTOR DEVELOPMENT Final Report, Jun. 1961–Sep. 1964
J. Weisman, ed. Oct. 1964 45 p refs
(Contract AT(30-1)-2827)
(WCAP-2666; EURAEC-1278)

Surface junctions which can detect charged particles have been developed in a project dealing with design of miniature silicon carbide neutron detectors. A good yield of detector diodes is produced by diffusing aluminum into SiC crystals at a predetermined depth; and such diodes are capable of counting thermal neutrons up to 800° C. A technique has been developed to convert these diodes into neutron detectors by vapor deposition of U^{235}. The resultant diodes have more radiation resistance than ordinary silicon diodes; lifetime of the SiC diodes, however, is only between 100 and 1000 seconds. There is evidence that these lifetimes can be increased by annealing the diodes at temperatures above 1000° C, but diode contacts will have to be developed to withstand this heat. M.W.R.

N65-35161# Boeing Scientific Research Labs., Seattle, Wash.
SOLID STATE PHYSICS LABORATORY REVIEW, JANUARY–JUNE 1965
E. B. Moore, Jr. et al [1965] 23 p refs

Work is reported on activities in solid state physics research. Discussed are: extended Hückel theory; the calculation of atom migration energies in solids; the use of non-variational methods for calculating electronic energies; electron paramagnetic resonance spectroscopy; radiation effects in insulators; X-ray spectroscopy; and gas adsorption on metals and alloys. Also discussed are: electron emission during metal fatigue; vapor-deposition of thin film piezoelectric transducers for high-frequency acoustic studies; the Mössbauer effect; nuclear magnetic resonance in a metal single crystal; power dissipation in resistive SII-type superconductors; anomalies of the phonon-electron interaction in Cu-Ni alloys; annihilation of defects under stress; deformation in ordered hexagonal alloys; and scattered light photoelasticity. L.S.

N65-35170# Philco Corp., Blue Bell, Pa. Applied Research Lab.
ON THE PHOTOIONIZATION OF DEEP IMPURITY CENTERS IN SEMICONDUCTORS
G. Lucovsky 1965 11 p refs
(Contract Nonr-4848(00))
(AD-619289)

The wavelength dependence of the photoionization cross section for deep, semiconductor impurity centers, e.g., in doped Si, is calculated using a model in which the ground state wave function is determined solely by a suitable short range ion core potential. Absorption to excited states is explained by a long range, unperturbed coulomb potential. Author

N65-35171# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE POSSIBLE GENERATION OF NEGATIVE TEMPERATURES IN A DOPED SEMICONDUCTOR UNDER STATIONARY EXCITATION
A. A. Kolesnikov and Z. I. Uritskiy 29 Jul. 1965 6 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 2, 1964 p 171–173
(FTD-TT-65-561/1+4; AD-619326)

It is shown that by experimentally determining the magnitude of the kinetic coefficient of the transition from the i-Th level to the l-Th level, and probability of elementary radiation transition at a frequency where $l > 1$, it is possible to evaluate the possibility of creating negative temperatures in semiconductors in a stationary regime of lighting. TAB

N65-35172# California Univ., Berkeley. Space Sciences Lab.
ON THE USE OF RUTILE AS AN 8MM MASER MATERIAL
Toshio Hori and Joseph Wakabayashi 20 Nov. 1964 103 p refs revised *Its* Ser. No. 5, Issue No. 39
(Contract Nonr-222(54))
(AD-619191)

This report is to present some considerations and experiments which were made in the course of design of an 8 mm traveling wave maser for radio astronomy application. In Part I a brief review of solid state maser theory and paramagnetic resonances will be made. In Part II some examples of the application of the spin Hamiltonian of paramagnetic material to maser design will be presented. Also, frequency characteristics of quarter wave matching transformers will be considered. At the end of Part II, the present scheme of impedance matching between standard waveguide to maser amplifier will be presented. In Part III, some experiments which have been done to support the matching design: determination of crystal axis by Laue back reflection method; measurement of dielectric constant of materials which will be used in constructing maser amplifiers. Also, experimental considerations on broad band matching will be presented. Author

N65-35231*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ANALYTICAL STUDY OF THE WORK FUNCTION CHARACTERISTICS OF A METAL IMMERSED IN CESIUM VAPOR-SURFACE CONTRIBUTION
Keung P. Luke [1964] 10 p refs Presented at the 24th Ann. Conf. on Phys. Electron., Cambridge, Mass., 25–27 Mar. 1964
(NASA-TM-X-51612) CFSTI: HC $1.00/MF $0.50 CSCL 20L

The reduction of the electron work function of an emitter and collector by absorbed cesium in a cesium thermionic diode is considered and an analytic expression to represent the change in electron work function with change of ratio of metal surface temperature to cesium reservoir temperature is derived. It is shown that because of the presence of the metal surface, it is necessary to consider the effective electric field acting on each adsorbed particle, the effective polarizability of each adsorbed particle, and the variation in atom desorption energy with gas coverage. E.E.B.

N65-35267*# Rice Univ., Houston, Tex.
THE MEASUREMENT OF SUPERPARAMAGNETIC PARTICLE SHAPES AND SIZE DISTRIBUTION
R. M. Asimow [1963] 39 p refs Submitted for Publication
(Grant NsG-6)
(NASA-CR-56920) CFSTI: HC $2.00/MF $0.50 CSCL 20L

A quantitative technique for the measurement of superparamagnetic particle shapes and size distribution is described. It is shown that magnetization curves for specimens containing superparamagnetic particles may differ from a Langevin function because of particle anisotropy, particle interactions, and because of the presence of a size distribution of particles. The various causes of particle anisotropy are considered, and

magnetization curves for specimens with cubic uniaxial anisotropy are presented. A graphical technique is developed whereby it is possible to separate the effects of the size distribution, the particle interaction, and the particle anisotropy. Thus it is possible to obtain quantitative values for both the particle shape and size distribution. G.A.L.

N65-35272*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VACANCY FORMATION IN GOLD UNDER HIGH PRESSURE
Hubert H. Grimes 8 Feb. 1964 19 p refs Submitted for Publication
(NASA-TM-X-51508) CFSTI: HC $1.00/MF $0.50 CSCL 20L

High-purity gold wires were resistively heated and quenched in a pure argon gas envoronment at pressures up to 6 kilobars. Quench rates of 10^4 to 5×10^4° C/sec were obtained by abruptly reducing the heating current. The resistance of both the specimen and an unquenched dummy specimen were measured in situ at −38° C with conventional circuits. The logarithm of the quenched-in resistance decreased linearly with increasing pressure at a constant temperature of 600° C. From these data, a formation volume of 0.52 ± 0.07 atomic volume was derived, which was assumed to be associated with the formation of single vacancies. For atmospheric pressure quenches from below 725° C, Arrhenius plots of the quenched-in resistivity for various quenching temperatures yielded an average formation energy for single vacancies of 0.93 eV. Above 725° C, the quenched-in resistivity drops below this line consistent with the complex annealing behavior during the quench observed by others for higher temperature quenches. The measured formation volume indicated a degree of relaxation around a vacancy that is shown to be in accord with previously calculated lattice relaxations obtained using potential function theory. Author

N65-35285*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FIELD AND CHARGE DEPENDENCE OF RADIATION DAMAGE IN SILICON
P. H. Fang [1963] 8 p refs Submitted for Publication
(NASA-TM-X-51640) CFSTI: HC $1.00/MF $0.50 CSCL 20L

By measuring the photovoltaic response of Si with shallow p-n junction as a function of optical wavelength, it is possible to determine the depth distribution of damages in Si. Methods for the analysis will be presented. There is evidence that the radiation damage depends, besides on the mass of the atoms (Si and the impurities), also on (1) the electric charge states of the crystal and the lattice, and (2) the internal field, such as, p-n junction field and the field produced by the concentration gradient in the crystal. Author

N65-35319# Hughes Research Labs., Malibu, Calif.
RESEARCH ON RARE EARTH FLUORIDE MATERIALS Interim Scientific Report, 1 Dec. 1964–26 Feb. 1965
A. L. Gentile [1965] 23 p refs
(Contract AF 33(615)-1999)
(ISR-1; AD-464996)

The work reported is directed toward the selection of those high quality rare earth fluoride materials which indicate the most promising host and dopant combinations, with optimum dopant concentration. The Bridgman technique has been used to grow single crystals of pure LaF_3, CeF_3, PrF_3, NdF_3, and CaF_2, in addition to a variety of concentrations of Nd^{3+}:LaF_3, Nd^{3+}-Ce^{3+}:LaF_3, and Nd^{3+}-doped CeF_3 and CaF_2. Two crystals of 1% NdF_3 doped LaF_3 were tested for laser action. The higher optical quality material required a threshold energy of 27.5 J. The spectroscopy of rare earth impurities in LaF_3 proceeded with the purpose of determining line positions and shapes as a function of impurity concentration. Experiments to determine the precise nature of ion to ion energy transfer presently indicate resonance transfer as the dominant mechanism. A study of concentration dependence of fluorescent behavior of Pr^{3+} in CaF_2 indicated that the relative quantum efficiency decreases with Pr^{3+} concentration. Author

N65-35348# Harvard Univ., Cambridge, Mass. Gordon Mc Kay Lab.
THE OPTICAL PROPERTIES OF THIN GERMANIUM FILMS
Paul Michael Grant Jun. 1965 210 p refs
(Contract Nonr-1866(10))
(HP-14; AD-619071)

An investigation into the optical properties of thin germanium films is described. The central topic is the deduction of the optical constants from photometric measurements on epitaxial films on CaF_2 in the range 2000 to 6000 Å. Methods of film production are discussed and the effect of deposition parameters on the crystallinity and reflectivity of films on fused quartz and CaF_2 are presented. It was concluded that epitaxial films give excellent agreement with bulk single crystals as regards interband transition structure in their reflectivity and transmissivity coefficients. Theoretical studies were carried out on the accuracy of derivation of the optical constants from measurements of normal incidence reflectivity and transmissivity coefficients. The optical properties of epitaxial germanium films replicate bulk single crystals to a degree sufficient to justify their consideration as vehicles for further optical research into the high energy, high absorption spectral regions. Also, the use of epitaxial semiconductor films to calculate optical constants will supplement but not supplant other methods such as polarimetry and dispersion analysis. E.E.B.

N65-35356*# AVCO-Everett Research Lab., Everett, Mass.
EXPERIMENTAL INVESTIGATION OF ADVANCED SUPERCONDUCTING MAGNETS. SUPERCONDUCTING STRIP AND ITS USE IN MAGNETS Final Report
Ethan Hoag Sep. 1964 85 p
(Contract NAS8-5279)
(NASA-CR-67016) CFSTI: HC $3.00/MF $0.75 CSCL 20L

A theoretical and experimental program designed to (1) develop a reliable contact that could be used in high field superconducting magnets, (2) analyze the mechanism whereby current is transferred to a superconductor, (3) establish design parameters that would permit comparative measurements on various types of joints, and (4) to establish a testing procedure for making such comparative measurements; is reported. Presented are data on: superconducting to normal and superconducting connections, anomalies in the anisotropy of wide superconducting strips, heat treatment and its effect on performance, magnetization and the current density profile of superconducting strip, and superconducting strip coil. S.C.W.

N65-35362# Radio Corp. of America, Princeton, N. J. David Sarnoff Research Center.
LOW TEMPERATURE INFRARED PHOTOCONDUCTORS
M. L. Schultz 6 Jul. 1965 22 p refs
(Contract Nonr-2225(00))
(AD-619070)

Oscillations of photocurrent which are periodic in photon energy with a period equal to the longitudinal optical (LO) phonon energy have been investigated as a function of the

percentage absorption of the incident radiation and as a function of electric field. From the result that the oscillation amplitude is independent of fractional absorption, it may be concluded that the oscillatory effect is not due to a periodically varying absorption coefficient. The oscillation amplitude as a function of electric field is such that the amplitude is independent of field at low fields and that the oscillations disappear at fields above about 30 volts/cm. The results have been interpreted in terms of a model in which carriers excited to high energies by photon absorption first lose energy very rapidly by emission of LO phonons and then, more slowly, gain or lose energy by interaction with the electric field and with acoustical phonons during the lifetime of the carrier. If the photoconductive gain is a function of carrier energy, the existence of oscillations and the form of the electric field dependence of the oscillation amplitude can be predicted. Author

N65-35385# Oxford Univ. (England). Clarendon Lab.
PROPERTIES OF RARE EARTH AND TRANSITIONS IONS Final Report
A. H. Cooke, ed. 10 Jul. 1965 145 p refs
(Contract AF 61(052)-677)
(AFCRL-65-687) CFSTI: HC $1.00/MF $1.00

This report describes the preparation of single crystal specimens containing rare earth elements or other magnetic centres, and the investigation of their magnetic properties, by optical techniques, by magnetic resonance and by specific heat and magnetic susceptibility measurements. Author

N65-35419# Linde Div., Union Carbide Corp., Indianapolis, Ind. Speedway Labs.
CZOCHRALSKI RUBY Semiannual Technical Summary Report, 1 Jan.–30 Jun. 1965
O. H. Nestor 29 Jul. 1965 36 p refs
(Contract Nonr-4132(00); ARPA Order 306-62; Proj. Defender)
(SRCR-65-5; AD-618752)

The experimental program on growth of ruby crystals by the Czochralski technique during this report period has emphasized improved control over temperature fluctuations and temperature gradients in the system, to increase still further the homogeneity of the product. A thorough evaluation of the optical and crystallographic properties of Czochralski ruby is presented, showing the uniformly high quality of the material when grown with preferred orientations. The optical quality of Czochralski ruby ranges from very good for 60° and good for 90° crystals to fairly poor for 0° material. Both 60° and 90° crystals are of exceedingly high crystallographic perfection; 0° crystals are markedly inferior, exhibiting misorientations and dislocation densities of much greater magnitude. The fluorescence linewidth of Czochralski ruby is essentially independent of crystal orientation and is unaffected by annealing; an apparent concentration dependence is observed, with higher linewidths at higher chromium concentration levels. Author

N65-35429# United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH PROGRAM ON NEW PEROVSKITE LASER HOST MATERIALS OF THE $A[B'_{0.5}\ B''_{0.5}]O_3$-TYPE HAVING CUBIC CENTROSYMMETRIC LATTICE SITES Final Report, Aug. 1, 1964–Jul. 31, 1965
F. S. Galasso, G. K. Layden, and D. E. Flinchbaugh Jul. 1965 119 p refs
(Contract Nonr-4606(00); ARPA Order 306)
(UACRL-D910269-5; AD-618936)

Powders of perovskite-type compounds having the general formula $Ba(B'_{0.5}Ta_{0.5})O_3$, where B' is a trivalent rare earth cation, In^{3+}, Y^{3+}, or Sc^{3+}, were doped with trivalent laser activating ions and the fluorescent lifetimes were measured. The values and long life-times obtained for other rare earth doped phases of this type indicate that some of them may make promising laser materials. In addition, the optical properties of a number of other complex perovskite phases and some non-perovskite phases were measured. Studies involving flux growth crystals were also made. In the first investigations, small, discolored crystals of $Ba(La_{0.5}Ta_{0.5})O_3$, $Ba(Gd_{0.5}Ta_{0.5})O_3$, $Ba(Lu_{0.5}Ta_{0.5})O_3$, $Ba(Sc_{0.5}Ta_{0.5})O_3$, and $Ba(Y_{0.5}Ta_{0.5})O_3$ were grown from a BaF_2 flux. After detailed phase diagram studies of the $BaO–YTaO_4–B_2O_3$ and $BaO–LuTaO_4–B_2O_3$ systems, clear single crystals of doped $Ba(Y_{0.5}Ta_{0.5})O_3$ and $Ba(Lu_{0.5}Ta_{0.5})O_3$ were grown from a B_2O_3 flux by slow cooling. In addition, a larger single crystal of $Ba(Y_{0.5}Ta_{0.5})O_3$ was grown by a modified Czochralski technique. Author

N65-35446# Holman (John F.) and Co., Inc., Washington, D. C.
CONTRIBUTION TO THE THEORETICAL AND EXPERIMENTAL STUDY OF THE HALL EFFECT IN A ROTATING ELECTRIC FIELD [CONTRIBUTION A L'ETUDE THEORIQUE ET EXPERIMENTALE DE L'EFFET HALL EN CHAMP ELECTRIQUE TOURNANT]
Robert Bonnefille Ft. Belvoir, Va., Army Eng. Res. and Dev. Lab., Aug. 1965 75 p refs Transl. into ENGLISH from French
(Contract DA-44-009-AMC-930(T))
(ERDL-T-1795-65; AD-618725)

A study of the behavior of a semiconductor platelet in the presence of a rotating electric field, and an application of this Hall effect is presented. It is shown that the Hall effect leads to the creation of an equivalent reactance independent of amplitude, and, to a large degree, of the frequency of the rotating field. This reactance, depending on the sense of rotation, is inductive or capacitive. The application is concerned with the automatic starting and speed regulation of a single phase induction motor. Two disadvantages of this motor are cited: (1) the starting torque is zero, and (2) the speed of the motor is dependent only on the opposing torque of the load. It is shown how these disadvantages can be overcome by replacing one of the rotor's short circuiting rings with a thin semiconductor disk subjected to a uniform magnetic induction field that is easily adjustable. C.T.C.

N65-35450*# Atomics International, Canoga Park, Calif.
INVESTIGATION OF CURRENT DEGRADATION PHENOMENON IN SUPERCONDUCTING SOLENOIDS Second Quarterly Progress Report, 15 Oct. 1964–15 Jan. 1965
L. C. Salter, Jr. [1965] 30 p refs
(Contract NAS8-5356)
(NASA-CR-67190; AI-65-42) CFSTI: HC $2.00/MF $0.50
CSCL 20L

Measurements of critical current density versus transverse field, upper resistive critical field, normal-state-resistivity at 4.2° K, and room temperature resistivity, were completed on Ti-Nb wire samples. Well defined maximums in critical current density and resistive upper critical field were found as a function of annealing temperature, and broader ranges of dependence were found for annealing times. Normal state resistivity measurements at 4.2° K and at room temperature were consistent with upper resistive critical field determinations. Quantitative correlations of variations in the upper resistive critical field are planned after the completion of critical temperature experiments. S.C.W.

N65-35456# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
ANTIFERROMAGNETISM OF α-FeOOH INVESTIGATED WITH THE MOSSBAUER EFFECT
A. Z. Hrynkiewicz, D. S. Kulgawczuk, and K. Tomala May 1965 9 p refs
(Rept.-410/PL) CFSTI: HC $1.00/MF $0.50

The temperature dependence of the internal magnetic fields in goethite (α-FeOOH) were measured with the method of the Mössbauer effect. The obtained results indicate the existence of the two types of the antiferromagnetic order.
Author

N65-35459# Gt. Brit. Ministry of Aviation, Nottingham. Technical Information and Library Services.
PERIODIC TEMPERATURE FLUCTUATIONS IN LIQUID InSb AS A CAUSE OF THE BANDING OF Te IN CRYSTALLIZING InSb [PERIODISCHE TEMPERATURSCHWANKUNGEN IN FLUSSIGEM InSb ALS URSACHE SCHICHTWEISEN EINBAUS VON Te IN KRISTALLISIERENDES InSb]
A. Müller and M. Wiehelm Aug. 1965 19 p ref Transl. into ENGLISH from Z. Naturforsch. (Tübingen), v. 19a, no. 2, 1964 p 254–263
(TIL/T-5535) CFSTI: HC $1.00/MF $0.50

This report discusses periodic temperature fluctuations which may occur in molten InSb and, when repeated periodically during the crystallizing of the melt, may cause the formation of bands of foreign substances perpendicular to the direction of crystallization. Conditions are given under which, during partial solidification (from one side) or zone-melting of InSb, a periodic, inhomogeneous absorption of foreign substances by the crystal persists.
Author

N65-35538# California Univ., La Jolla.
SUPERCONDUCTIVITY IN ONE AND TWO DIMENSIONS
T. M. Rice 13 Jul. 1965 11 p refs
(Contract Nonr-2216(11); Grant AF-AFOSR-610-64)
(TR-32; AD-618203)

The effect of thermodynamic fluctuations on off diagonal long range order is discussed. The two particle Yang correlation function is calculated using the Ginzburg-Landau theory allowing such fluctuations. The behavior of the correlation function at large separation is examined and it is found to be consistent with Yang's criterion in three dimensions. In one and two dimensions Yang's criterion is not satisfied.
Author

N65-35569# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A FEW CHEMICAL METHODS OF DETECTING THE CONDUCTIVITY TYPE OF SEMICONDUCTORS
Chen-Kun Chia 27 Jul. 1965 13 p refs Transl. into ENGLISH from Hua Hsueh Tung Pao (Peiping), no. 2, 1963 p 38–40
(FTD-TT-64-1340/1+2+3+4; AD-619313)

Several methods are given for determining the type of conductivity and location of P-N junctions in silicon and germanium semiconductors. These techniques are: staining with hydrofluoric acid; staining with hydrofluoric acid–nitric acid; preferential precipitation of copper; preferential precipitation of gold; preferential precipitation of silver; electrolytic action; and anodic etching.
TAB

N65-35595# Stanford Research Inst., Menlo Park, Calif.
RELIABLE DIELECTRIC FILMS FOR MICROCIRCUITS Final Report, 1 Apr. 1964–31 Mar. 1965
Saul W. Chaikin and Gilbert A. St. John May 1965 66 p refs
(Contract DA-36-039-AMC-02204(E))
(AD-617958)

By means of electron microscope study techniques, important properties of aluminum electrode edges were determined. It was established that the surface of the film was smoother at its edge than in the planer area, the aluminum crystal size becomes smaller as the edge becomes thinner, and the edge slope of practical electrode thicknesses and mask spacings was probably 5° or less, partly because diffusion of aluminum atoms on the substrate surface occurs. It was found that electrical leakage of SiO capacitors was enormously sensitive to deposition rate and somewhat sensitive to thickness; and that deposition rate and thickness interact in their effect on leakage. It was concluded that low deposition rate and high residual gas pressure favor incorporation of oxygen into the film and shift the oxygen/silicon ratio from SiO toward SiO_2. This confers SiO_2 electrical properties on the film, resulting in reductions in dielectric constant, dissipation factor, leakage, and TCC.
R.W.H.

N65-35599# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGNING A 4-CONTACT METHOD FOR MEASURING THE SPECIFIC ELECTRIC CONDUCTIVITY OF THIN SEMICONDUCTOR FILMS
Yu. P. Kozhevnikov 1 Jul. 1965 6 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Fiz. (Tomsk), no. 2, 1964 p 173–175
(FTD-TT-65-668/1+2+4; AD-617161)

A simple formula which couples the electric conductivity of the film with the potential difference between the measuring contacts the current strength, the film thickness, and the geometric parameters of the contacts were obtained by solving the equation for the potential ϕ which describes the electrical field giving rise to the current in the film. The distribution of current in the film is described by the current density.
R.W.H.

N65-35605# General Telephone and Electronics Labs., Inc., Bayside, N. Y.
STUDY OF ADSORPTION OF GASES ON SOLIDS IN THE HIGH VACUUM RANGE Final Report, 1 Jan. 1962–31 Dec. 1964
C. M. Bliven, J. V. Florio, and D. H. Baird 28 Feb. 1965 57 p refs
(Contract AF 19(628)-331)
(TR-65-255-9; AFCRL-65-137; AD-615040)

Studies on the adsorption of gases on solids were carried out in two separate ultra-high vacuum systems; one, designed specifically for measuring sticking coefficients and number of adsorbed molecules (nitrogen on tungsten) and the other designed primarily for measuring work function changes due to the adsorption of gases (oxygen and carbon-monoxide on molybdenum and tungsten). Investigation of the interaction of nitrogen with a hot tungsten filament showed that a chemical pumping effect occurs and that the magnitude of this effect varied with temperature. In studies of the adsorption of oxygen on molybdenum and tungsten, the sticking probability and molybdenum work function changes were calculated as a function of oxygen surface coverage, neglecting the carbon monoxide background caused by chemical reactions between the oxygen and carbon impurities in the tube parts.
Author

N65-35680# New York Univ., N. Y. Dept. of Physics.
ENERGY TRANSFER DURING TRANSIENT NUCLEAR PULSES Semiannual Report, 1 May–31 Oct. 1964

Hartnut P. Kallmann Nov. 1964 28 p refs
(Contract DA-043-AMC-00129(E))
(SAR-1; AD-617782)

The atomic mechanism of the electrical effects created by the interaction of X-ray radiation with insulating materials of cross-linked polystyrene samples were studied. The following interaction processes were observed: (1) An applied electrical field produced charge separation and accumulation with or without radiation; (2) accumulation occured in thin layers of 0.25 mm to 0.5 mm close to the electrode-barrier-interface; (3) radiation without an external field and without previous polarization did not produce charge accumulation; (4) radiation plus electrical field increased the polarization by about 30% for short periods; (5) radiation during charge decay increased the total amount of discharge; (6) the insulator responses to X-rays depended on the field application, and on the irradiation; and (7) the boundary layer between two insulators served as a collecting surface for charge layers. It was concluded that high energy radiation effected insulators almost exclusively by electronic excitations and ionizations. G.G.

N65-35691# California Univ., Los Angeles.
INVESTIGATIONS ON THE CONFIGURATIONAL EMF
M. Chester 20 Jun. 1965 7 p refs
(Contract Nonr-233(72))
(AD-617697)

A program focusing on the detection and measurement of a type of Bernoulli effect in the electron gas in silicon germanium, and superconducting tin, is reported. The technique employed consisted of looking for harmonic voltage generation due to the physical constriction on the current flow imposed by the shape of the specimen. Electronic equipment was tested on pseudospecimens consisting of good resistors or resistors in combination with diodes placed so as to stimulate the harmonic generation effect of the cross sectional area steps. Resistors without diodes showed no signals at frequency 2f to better than one part in 10^7. Hundreds of microvolts of second harmonic instead of the expected microvolt signals were measured in the test specimens. Tests indicated that although these signals were produced in the specimens, their origin was not in the step in cross sectional area. It was found that the second harmonic production arose at regions throughout the specimen from inhomogeneities in the material used. Several techniques were studied to circumvent this problem. In view of the high degree of homogeneity, and high mobility of lead telluride at low temperatures, studies of epitaxially grown lead telluride films were undertaken. Although fine structural properties were exhibited for films grown both on KCl and NaCl, attempts to obtain films with electrical properties analagous to those reported in the literature were unsuccessful. S.C.W.

N65-35695# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN CHARACTERISTICS CONCERNING THE EFFECT OF X- AND GAMMA-RAYS ON THE ELECTRICAL RESISTANCE OF CdS CRYSTALS
M. A. Talibi and A. G. Yusifov 2 Jul. 1965 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Mat. i Tekhn. Nauk (Baku), no. 6, 1960 p 91–97
(FTD-TT-64-1162/1+2+4; AD-617673)

The radiation effects of X-rays and gamma radiation on the electrical resistance of CdS crystals were investigated at various wavelength and intensity values. The source of the gamma radiation was Co^{60} and the variation in intensity was accomplished by change in distance from source to sample. The change in X-ray radiation intensity was realized by changing the current through the X-ray tube and the distance between the tube window and the sample surface. Filters were also employed to change the intensity of the x-rays. Dosage was determined by an ionization chamber with walls made of air equivalent material. It was determined that, when a CdS crystal is used in the role of dosimeter for gamma and X-ray radiation, calibration of the sensor is required. Cadmium sulfide was found to be sensitive to wavelength and frequency variations when used as a dosimeter element. E.E.B.

N65-35708# Louvain Univ. (Belgium). Lab. of Physical Chemistry.
QUENCHING AND POST-IRRADIATION STUDIES ON CdS SINGLE CRYSTALS. TRANSPORT PROPERTIES OF BISMUTH ROLLED THIN FOILS Final Scientific Report, 1 Apr.–30 Nov. 1964
André Luyckx, Jean-Paul Issi, Jean-Marie Streydio, Jean-Pierre Michenaud, Paul Coopmans et al Jan. 1965 57 p refs
(Contract AF 61(052)-776)
(RADC-TR-65-156; AD-614485)

Post-irradiation of CdS doped single crystals with quenching wavelengths produces at room temperature, a sharp peak of photocurrent. Electrons are freed from traps between 1.0 and 1.65 ev below the conduction band and holes from traps between 0.70 and 1.65 ev above the valence band. Some of the levels and relative densities of electrons have been determined. Thermal conductivity of polycrystalline and rolled Bi have been compared from 80 to 300° K. Author

N65-35715# Raytheon Co., Waltham, Mass. Research Div.
MICROWAVE NONLINEAR DIELECTRIC MATERIALS Final Report, 15 Sep. 1963–14 Oct. 1964
M. Harris, J. S. Waugh, A. Paladino, and P. B. Nutter [1964] 71 p refs *Its* Rept.-16
(Contract DA-36-039-SC-89126; DA-36-039-AMC-03389(E))
(S694; AD-614274)

Microwave nonlinearity and loss tangent data for alumina and stannate-doped $(Ba_{0.5},Sr_{0.5})TiO_3$ (BST-50) near the Curie temperature are presented. A hot-pressed, annealed sample is included among the above materials. Similar data on alumina- and lanthana-doped $(Ba_{0.7},Sr_{0.3})TiO_3$ (BST-70), including a hot-pressed, annealed sample are presented. No unusual behavior was observed, and it is concluded that hot-pressing and annealing do little to improve the behavior of mixed titanate ceramics near the Curie temperature. A $BaTiO_3$ ceramic doped with two mole percent of lanthana (La_2O_3) exhibited an extrapolated Curie temperature of +30° C. Its nonlinearity and loss at the Curie peak were both comparable to those of BST-50 or BST-70. Lanthanum additions to $SrTiO_3$ depressed the Curie temperature by an amount of 30 to 40° C/mole percent lanthanum. The frequency dependence of the loss tangent of BST-50, BST-70, and lanthana-doped $BaTiO_3$ is seen to deviate strongly from linear dependence near the Curie temperature. The frequency ranges used were 2 to 4 Gc/sec and 8 to 12 Gc/sec. Author

N65-35764# Parke Mathematical Labs., Inc., Carlisle, Mass.
INDIRECT DISPLACEMENT OF ATOMS IN SOLIDS BY KNOCK-ON IMPURITY ATOMS Scientific Report No. 5
Charles H. Sherman Mar. 1965 46 p refs *Its* Rept.-2419-SR-5
(Contract AF 19(628)-2419)
(AFCRL-65-255; AD-615550)

A cascade theory is developed in order to calculate the number of displaced atoms of a host material produced by

knock-on impurity atoms. The theory is similar to the Kinchin–Pease cascade theory except that the atom which starts the cascade differs in mass from the other atoms with which it collides. The chief application of the theory is for evaluating the number of host displacements produced indirectly by knock-on impurities in radiation damage experiments. This is of interest as a subthreshold effect and also as a possible source of error in determining the threshold for atomic displacement. The basic results are evaluated numerically for a wide range of cases which cover most situations of interest in radiation damage experiments. Numerical results are also given for the specific examples of carbon and rhodium impurities in platinum which show that in these cases the number of indirect displacements produced by knock-on impurities is negligible for most purposes. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-34840 Illinois Univ., Urbana.
A SUMMARY OF LINEAR VISCOELASTIC STRESS ANALYSIS
Harry H. Hilton *In* Calif. Inst. of Tech. Solid Rocket Structural Integrity Abstr. Apr. 1965 p 1–56 refs (See N65-34839 23-28)

Developments in linear viscoelastic stress analysis as they affect solid propellant grain analysis are summarized. In discussing stress–strain relationships, various experimental approaches resulting in analytical and/or graphical representations were reviewed. Such approaches to viscoelastic stress analysis as direct solutions, exact analogies, approximate analogies, and approximate solutions are briefly described. References are cited, and a bibliography is included to provide background material for a detailed study of the linear viscoelasticity field. M.G.J.

N65-34852# Rohm and Haas Co., Huntsville, Ala. Redstone Arsenal Research Div.
HIGH PRESSURE SOLID PROPELLANT COMBUSTION STUDIES USING A CLOSED BOMB
Richard B. Cole [1965] 63 p refs
(Contracts DA-01-021-ORD-11909(Z); DA-01-021-AMC-11536(Z))
(S-68; AD-471575)

A self-pressurizing closed-bomb system is described for observing deflagration characteristics of solid propellants at pressures as high as 200 000 psi. Regression rates are obtained by microwave interferometry, a newly-adapted method which eliminates the need for introducing foreign bodies in the forms of wires, probes, etc., into the system. Pressure measurements are made with strain gauges mounted on the exterior of the bomb body, obviating many sealing problems associated with conventional transducers. The relative merits of the available instrumentation are discussed; the principles and limitations of the interferometry technique are treated in detail. Preliminary r-P data for a polybutadiene–acrylic acid composite propellant are reported up to 60 000 psi; results at higher pressures are indeterminate, owing to leakage and lack of high-pressure dynamic calibration equipment. Author

N65-34857# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
RECALIBRATION OF THE STANDARD GARD-GAP TEST
Thomas P. Liddiard, Jr. and Donna Price Oct. 1965 52 p refs
(NOLTR-65-43, AD-470648)

A new calibration of peak pressure (P) vs gap length (X) is presented for the NOL standardized and modified gap tests. It is shown that experimental values of both shock velocity (U) and particle velocity (u) are required to obtain a valid P-X curve at low pressures, because the normally linear U-u curve for the gap material exhibits a discontinuity at about X = 50 mm. The initial free-surface velocity ($u_{fs} \cong 2u$) is determined by monitoring films placed at the end of the gap. Author

N65-34994# Stauffer Chemical Co., Richmond, Calif. Western Research Center.
HIGH ENERGY OXIDIZERS Quarterly Technical Summary Report, May 1–Jul. 31, 1965
Karl O. Christe, J. P. Guertin, A. E. Pavlath, and E. G. Wallace [1965] 25 p refs
(Contract Nonr-4019(00); ARPA Order 399-62)
(AD-470294)

Infrared and conductivity measurements show that $MClF_4$ (where M is NO, Rb, or Cs) is ionic in the solid state and in solution, respectively. A square-planar structure (point group D_{4h}) is assigned to the ClF_4^- anion in $Rb^+ClF_4^-$ and $Cs^+ClF_4^-$. For the ClF_4^- anion in $NO^+ClF_4^-$ the low-temperature infrared measurement indicates a lower symmetry (at least as low as point group D_{2h}). A vacuum line, which will enable us to run glow-discharge reactions at low temperatures and reduced pressures, was designed and built. Density measurements on the alkali metal difluorochlorates(I) indicate that the X-ray patterns given in the preceding Quarterly Report are probably due to small amounts of alkali metal bifluorides present as impurities. Author

N65-35109*# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
FAILURE OF AN INERT COMPOSITE PROPELLANT UNDER MULTIAXIAL STRESS FIELDS Technical Report No. 1
M. G. Sharma and C. K. Lim Mar. 1965 49 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950875)
(NASA-CR-67235) CFSTI: HC $2.00/MF $0.50 CSCL 21I

The failure criteria of an inert composite solid propellant were evaluated under five biaxial tension stress fields. The effect of rate of loading on failure behavior of the material is considered. A new biaxial testing machine used for failure studies of the inert composite propellant is described. Possibilities of describing failure in terms of octahedral shear stress, octahedral shear strain, and maximum strain energy hypotheses are discussed. Failure curves in the principal stress space indicate that induced anisotropy exists in the material at fracture perhaps due to dewetting occurring in certain biaxial stress states. Maximum strain energy at fracture for various biaxial stress field evaluated from creep behavior in tensile and volumetric deformation agrees well with experimentally determined energy at fracture for most biaxial stress fields. However, for low biaxial stress ratios, predictions based on the finite deformation theory agree better. R.N.A

N65-35394*# National Aeronautics and Space Administration, Washington, D. C.
HANDLING HAZARDOUS MATERIALS Technology Surve
D. R. Cloyd and W. J. Murphy, ed. Sep. 1965 101 p refs
(NASA-SP-5032) GPO: $0.45; CFSTI: MF $0.75 CSCL 21I

The hazards, handling, and safety procedures are presented for liquid hydrogen, pentaborane, fluorine, chlorine trifluoride, ozone, nitrogen tetroxide, and hydrazine compounds. Each material is described and information is provided regarding its dynamic characteristics. Also, a chapter on fire extinguishment is included. E.E.B.

N65-35397*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.
INVESTIGATION OF LIGHT HYDROCARBON FUELS WITH FLOX MIXTURES AS LIQUID ROCKET PROPELLANTS Final Report, 30 Jun. 1964–30 Jun. 1965
1 Sep. 1965 274 p refs
(Contract NAS3-4195)
(NASA-CR-54445; PWA-FR-1443) CFSTI: HC $6.00/MF $1.50 CSCL 21I

An analysis was completed for determination of the most promising hydrocarbon fuels for use with flox in upper stage rocket engines. Experimental rocket firings in uncooled, transpiration cooled, and regeneratively cooled thrust chambers were conducted using flox with methane, propane, butene-1, and a eutectic blend of pentane and isopentane. Experimental heated tube heat transfer and hypergolicity tests were conducted, and laboratory determinations of physical properties of various blends of hydrocarbon compounds were made.
Author

N65-35638# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
CONTINUOUS MEASUREMENT OF SOLID PROPELLANT BURNING RATES Final Report
J. R. Osborn, R. J. Burick, and R. F. Panella Jul. 1964 35 p refs
(Grant AF-AFOSR-207-63)
(JPC-386; F-64-3; AD-615816)

An experimental apparatus has been developed for the direct and continuous measurement of the burning rates of solid rocket propellants under conditions closely approximating those occurring in a solid rocket motor. The apparatus utilizes a positioning type servomechanism as a feed system which moves a sample of solid propellant within a two-dimensional rocket motor so that the receding burning surface of the sample is maintained at a fixed position with respect to the motor walls. Because the burning surface is maintained at a fixed position, the measurement of the velocity of the propellant feed system is identical with the burning rate. The servomechanism incorporates a 50 millicurie cesium-137 source of gamma rays coupled with a scintillation probe for detecting the position of the burning propellant surface. A ratemeter is employed for converting the output of the probe into a voltage which is then amplified and compared to a standard voltage that is proportional to a desired position for the propellant surface. The experimental data were obtained with the above servomechanism for two composite propellant formulations, for combustion pressures ranging from 125 to 505 psia, and for burning rates ranging from 0.16 to 0.33 in/sec. The data correlated well with previously published data. A theoretical analysis of the servomechanism was performed for determining the stability and performance of the system. Author

N65-35665# Atlantic Research Corp., Alexandria, Va.
RESEARCH ON THE DEFLAGRATION OF HIGH-ENERGY SOLID OXIDIZERS Quarterly Technical Summary Report No. 11, 1 Dec. 1964–28 Feb. 1965
J. B. Levy, G. von Elbe, R. Friedman, S. J. Adams, E. T. Mc Hale, and C. Midkiff 19 May 1965 18 p refs
(Contract AF 49(638)-1169)
(AD-617272)

Flame temperature above deflagrating hydrazine diperchlorate has been measured with ceramic-coated Pt-Pt, 10% Rh thermocouples, and with uncoated chromel-alumel thermocouples. A flame temperature of about 1350° K is indicated for an ambient pressure of about 20 atmospheres. This is substantially below the theoretical flame temperature of about 1600° K. The thermal decomposition of hydrazine diperchlorate has been investigated from 211–291°C. Ammonium perchlorate, nitrogen, oxygen, hydrogen chloride, nitrous oxide and hydrogen have been identified as products; and qualitative evidence of the formation of perchloric acid has been obtained. Quantitative analysis of the products has allowed a stoichiometric equation to be written. Ammonium perchlorate has been found in the surface of a strand of hydrazine diperchlorate which had been ignited at an elevated pressure, allowed to deflagrate partially, and extinguished by sudden pressure release. Deflagration rate measurements from 6 to 130 atmospheres are reported for pressed hydrazine diperchlorate. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-34839# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
SOLID ROCKET STRUCTURAL INTEGRITY ABSTRACTS, VOLUME 2, NO. 2
R. A. Westmann, ed. Apr. 1965 127 p refs
(Contract AF 04(611)-9572)
(AD-464736)

CONTENTS:

1. A SUMMARY OF LINEAR VISCOELASTIC STRESS ANALYSIS H. H. Hilton (Ill. Univ.) p 1–56 refs (See N65-34840 23-27)

ABSTRACTS

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8. PHYSICO-CHEMICAL EFFECTS ON MECHANICAL BEHAVIOR p 115–116

N65-34907*# Northrop Space Labs., Huntsville, Ala.
MANNED FLYING SYSTEMS (MFS) CRYOGENIC ENGINE
F. B. Tatom and L. M. Bhalla Sep. 1965 67 p refs
(Contract NAS8-20082)
(NASA-CR-61101) CFSTI: HC $3.00/MF $0.75 CSCL 21H

The results are presented of a preliminary investigation to compare the performance of a cryogenic (liquid oxygen and liquid hydrogen) propulsion system with an earth storable (nitrogen tetroxide and a 50:50 mixture of hydrazine and unsymmetrical dimethylhydrazine) propulsion system for the Manned Flying System (MFS). The mass of the propulsion system necessary to meet the mission requirements of the MFS, as outlined in the Apollo Extension System Studies, is used as

the basis for comparison. A semi-empirical mathematical model is developed to predict the mass of the propulsion systems. The results, which are presented in both tabular and graphical form, indicate that the cryogenic system offers no apparent advantage over the earth storable system under the present state-of-the-art. Author

N65-34909*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PLASMA JET TECHNOLOGY

P. R. Dennis, C. R. Smith (Williams (Clyde) and Co.), D. W. Gates, and J. B. Bond, ed. Washington, NASA, Oct. 1965 207 p refs *Its* Technology Survey

(NASA-SP-5033) GPO: HC $1.00; CFSTI: MF $1.25 CSCL 21C

Presented is a survey of present industrial applications of plasma-arc devices and plasma-arc processes with emphasis on materials testing, coating, spraying, chemical syntheses, particle preparation, etc. The use of plasma devices led to the development of a vortex-stabilized radiation source where a brightness of 5,000 candles per sq. millimeter and a luminous efficiency of 60 lumens per watt may be achieved. G.G.

N65-34998*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NASA RESEARCH ON THE AERODYNAMICS OF JET VTOL ENGINE INSTALLATIONS

Richard E. Kuhn and Marion O. Mc Kinney, Jr. Washington, NASA [1965] 31 p refs Presented at the AGARD Specialist Meeting on Aerodyn. of Power Plant Installation, Tullahoma, Tenn., 25–27 Oct. 1965

(NASA-TM-X-56820) CFSTI: HC $2.00/MF $0.50 CSCL 21E

This paper summarizes some of the more pertinent results of NASA investigations related to the aerodynamics of jet VTOL engine installations. It shows that there is a base loss in hovering due to suction forces creased on the underside of the fuselage by the entrainment of ambient air in the slipstream, and that the magnitude of this effect is related to the turbulence in the jet stream and its consequent rate of mixing with ambient air. It also shows that there are large lift losses and pitching moments due to jet-free-stream interference and that these characteristics can be significantly altered by proximity to the ground. And, finally, it shows that simple bellmouth inlets give good pressure recovery and low distortion for vertically mounted lift engines if the inlet lip radius is sufficiently large, but that such inlets are not suitable for windmill starting of the engines. Author

N65-35119*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EXPERIMENTAL MEASUREMENTS ON A ROTATING DETONATION-LIKE WAVE OBSERVED DURING LIQUID ROCKET RESONANT COMBUSTION

R. M. Clayton and R. S. Rogero 15 Aug. 1965 28 p refs (Contract NAS7-100)

(NASA-CR-67259; JPL-TR-32-788) CFSTI: HC $2.00/MF $0.50 CSCL 21H

A single high amplitude pressure wave rotating with supersonic velocity about the combustion chamber axis was observed during the resonant combustion mode of liquid rocket engines. The applicability of a rotating detonation wave concept was studied to explain the phenomenon. Results are presented showing the chamber boundary pressure distribution associated with resonant combustion exhibited by one of the engines. The pressure distribution was obtained by measuring high frequency responses across the injector face radius and along the cylindrical chamber length. The pressure-wave-to-chamber-wall intersection curved in the direction of wave rotation with the nozzle end of the intersection leading the injector end in excess of 40 deg circumferentially. The wave-to-injector-face intersection was nonradial and extended into the central area of the face. The pressure ratio across the wave front varied along the chamber wall from more than 20 to 1 near the injector to 4 to 1 near the nozzle entrance. The face pressure ratio varied from 20 to 1 in the outer half radius to less than 4 to 1 near the center. The nonsymmetrical wave showed a rise time of less than 3 microsec at certain boundary locations. R.N.A.

N65-35226*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PROPULSION FOR HYPERSONIC TRANSPORT AIRCRAFT

Richard J. Weber [1964] 32 p refs Presented at the 4th Congr. of the Intern. Council of the Aeron. Sci., Paris, 24–28 Aug. 1964

(NASA-TM-X-51638) CFSTI: HC $2.00/MF $0.50 CSCL 21E

The problem of achieving efficient, long-range hypersonic flight with turboramjet engines is examined. The performance of integrated engine-airframe configurations is studied in order to obtain meaningful results. After including appropriate off-design penalties and observing a 2-pound-per-square-foot limit on sonic-boom overpressure, the typical range of 2800 nautical miles is calculated for a Mach 6 cruise airplane (125 passengers and 500 000-lb gross weight) with JP fuel. To obtain longer ranges, improvements must be made in the assumed engine performance or an unconventional fuel such as hydrogen must be employed. Author

N65-35535# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE USE OF A COANDA NOZZLE WITH PARALLEL SECONDARY INJECTION FOR THE THRUST VECTORING OF A TWO-DIMENSIONAL COMPRESSIBLE FLUID

Philip P. Panzarella (M.S. Thesis) Mar. 1965 133 p refs

(GAM-65A/ME/65-7; AD-618025)

An experimental investigation was performed to determine the effect of parallel injection of a secondary fluid on a two-dimensional coanda-effect nozzle used as a thrust vectoring (jet-switching) device. The effect of leakage in the vortex area of a conventional coanda-effect nozzle utilizing perpendicular secondary injection was also determined. The coanda-effect nozzle used in the investigation had a wall divergence half angle of 10° and a setback ratio that varied from 4 to 7. Pressure ratios investigated varied from 1.63 to 3.39. Successful thrust vectoring was accomplished within the above limits of setback and pressure ratios. Interferometer and Schlieren photographs of the thrust vectoring phenomena that occurred throughout the investigated setback and pressure ratio range are included in the report. Author

N65-35636# Toronto Univ. (Ontario). Inst. of Aerospace Studies.

AN EXPERIMENTAL INVESTIGATION INTO THE SHAPE OF THRUST-AUGMENTING SURFACES IN CONJUNCTION WITH COANDA-DEFLECTED JET SHEETS, PART II

T. Mehus Ft. Eustis, Va., Army Transportation Res. Command. Mar. 1965 75 p refs

(Grant DA-TC-44-177-G1)

(UTIAS-TN-79; USATRECOM-TR-65-8; AD-614617)

The subject was to increase the thrust augmentation of a configuration consisting of a Coanda surface (quadrant), deflecting the primary jet sheet through 90°, in conjunction with additional (thrust-augmenting) surfaces. The effect of a horizontal and vertical gap between the lip of the nozzle and the leading edge of the deflection surface, as well as the effect of

a gap between its trailing edge and the downstream diffuser wall was studied for a convergent and a convergent–divergent nozzle at various pressure ratios. The subsonic jet sheet produced the highest thrust augmentation. The highest total thrust augmentation observed was 1.37. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-34945 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPECTED ANISOTROPY OF NONTHERMAL COSMIC RADIO EMISSION AT LOW FREQUENCEIS

G. G. Getmantsev *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 252–255 refs (See N65-34925 23-30)

As experiments have shown that the radio emission intensity diminishes with increasing frequency, the explanation is offered that the bend in the frequency spectrum of radio emission at frequencies, $f < 5$ Mc, is due to increased absorption of cosmic radio emission in interstellar ionized gas concentrated near the galactic plane. At these relatively low frequencies, the intensity of the received radio emissions should be determined by sources situated in a quasispherical region whose radius is found from the condition $\tau = \mu r \simeq 1$, where τ is the optical thickness of a region of radius, r, and μ is the absorption coefficient of radiowaves at the corresponding frequency. Assuming that this model is correct, it is pointed out that an unusual and very strong anisotropy should be observed at relatively low frequencies ($f \lesssim 5$ Mc) in the angular distribution of the nonthermal cosmic radio emission. Supporting data are presented, and possible applications to interstellar space investigations of findings from detection and measurement of angle anisotropy at low frequencies are discussed. M.G.J.

N65-34946 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEASUREMENTS OF SOLAR Lα RADIATION ABSORPTION IN THE EARTH'S UPPER ATMOSPHERE

V. V. Katyushina *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 256–263 refs (See N65-34925 23-30)

Two ionization chambers filled with nitric oxide with a lithium fluoride window were used to measure the Lα intensity and its variations with altitude. In the instruments, the ionization chamber current that appears under the action of the radiation, which ionizes the nitric oxide, is amplified and converted into a signal for transmission to the telemetry system. The two experiments, conducted on June 6 and 18, 1963, took place in the morning when the sun was near the horizon, making it possible to measure the absorption up to high altitudes. The instruments were mounted on self-orienting separable containers which were lifted to an altitude of approximately 500 km; the ionization chamber windows were pointed at the sun during the entire period of stabilized flight. Data obtained from the two flights are discussed and compared with laboratory values. Results indicate that a change in the molecular oxygen concentration or overall density, by a factor of approximately 2, was detected at altitudes of 80 to 90 km. Since the solar activity on both days were approximately the same, the possibility was mentioned that the density variations may be connected with geomagnetic activity which was lower on June 6 M.G.J.

N65-35026# International Geophysical Year World Data Center A, Boulder, Colo. High Altitude Observatory.

OBSERVATION OF JUPITER'S SPORADIC RADIO EMISSION IN THE RANGE 7.6-41 Mc/s JANUARY 1964 THROUGH MAY 1965

James W. Warwick and George A. Dulk 16 Aug. 1965 39 p ref *Its* Solar Activity Rept. Ser. No. 32

A catalog is presented of Jupiter decametric emissions recorded on the High Altitude Observatory's Boulder spectrograph from January 1964 through May 1965 in the range 7.6 to 41 Mc/s, and is an extension of a previous catalog which listed Jupiter emissions from 1960 through 1963. The data do not represent a completely random sampling of observations. Emissions can be predicted due to Jupiter's satellite Io effect on emissions. Special observations were made of some predicted emissions. Because of Io's importance in the decametric emission process, its position (angle from superior conjunction) is listed at the times of beginning and end of emission. A histogram of emission probability vs central meridian longitude (LCM) for apparitions of 1961 through 1964 is shown in Figure 1. Figure 2 shows histograms of emission probability vs Io's angle from superior conjunction. Figure 3 shows the emission probability vs LCM when Io was in five ranges of position labeled on the figure. Figure 4 shows the joint probability distribution for emission as a function of the LCM and of Io's position. Figure 5 illustrates Io's effect on the spectral character of early source emissions. R.N.A.

N65-35077# Hebrew Univ., Jerusalem (Israel). Dept. of Physics.

X-RAY EXCITATION OF THE SECOND POSITIVE AND FIRST BANDS OF NITROGEN

W. Low 1964 8 p refs Prepared jointly with MIT
(Contract N-62558-4347)
(AD-619288)

It is shown that X-rays can produce emission of light in air and can excite the second positive and first negative bands of nitrogen found so prominently in aurorae. TAB

N65-35137# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE POLARIZATION OF CELESTIAL X-RAYS. I: THEORY

Joseph F. Dolan Aug. 1965 37 p refs Prepared jointly with Harvard Coll. Obs.

The processes by which X-radiation may be emitted by celestial sources are investigated, and the net polarization such radiation would possess is predicted. The amount of polarization observed at the earth would depend both on the mechanism producing the radiation and on the fractional extent of the source over which it is coherently polarized. Highly polarized X-radiation would suggest synchrotron emission as the source mechanism. Radiation whose polarization is low but nonzero would be produced by synchrotron emission from a source whose magnetic fields are inhomogeneous on a large scale, or by bremsstrahlung of electrons whose velocity vectors lie in one predominant direction. Nonobservable polarization would result from sources of synchrotron radiation whose magnetic fields showed small-scale irregularities, from the bremsstrahlung of electrons whose velocity

vectors are either random or spherically symmetric in direction over the entire source, or from sources whose mechanism of producing the radiation imparts no net polarization, e.g., thermal radiation from neutron stars, line radiation from electronic shell transitions within atoms, and the inverse Compton effect. Author

N65-35193# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SOLAR FLARE HAZARDS: PREDICTABILITY
R. C. Good, Jr. Jul. 1965 46 p refs
(R65SD30; AD-618905)

The hazards of solar flares are discussed in some detail to show the need for prediction. Hazards are noted as protons, X-rays, ultraviolet, and radio interference. Since the first is potentially the most dangerous, some data on dosage during flares is presented to evaluate the hazards. Since flares occur at or near sunspots and since there seems to be a direct correlation with the characteristics of sunspots, some discussion is given of the dimensions and characteristics of sunspots. One prediction scheme is presented which involves the statistics of flares, and a scheme is described that is presently being used for flare studies. Author

N65-35196# Wisconsin Univ., Madison. Dept. of Meteorology.
A CORRECTION FOR THE NET RADIOMETER REFLECTION ERROR. ANALYSIS OF MEASURED NET RADIATION VALUES FOR CANADA
Denford D. Finke and Wayne M. Wendland Jul. 1965 81 p refs
(Contract Nonr-1202(07))
(TR-19; AD-618721)

A correction factor is developed to convert measured net radiation values obtained from a net radiometer to the net radiation for a lake based on the reflectance difference of water and polyethylene surfaces. The daily mean emitted upward radiation of lake and land surfaces are assumed equal. The downward directed radiation from the sky and sun over both land and water surfaces are also assumed equal. Therefore, the differences in the albedo and emissivity of the interface surfaces of land, polyethylene and water are the determining factors causing a difference in the net radiation of each body. Formulae are presented to calculate the reflectance of a polyethylene and water surface given the angle of incidence of the solar beam (date and time). The differences between polyethylene, water, and land are readily calculated. Since this correction is applied only to the direct solar beam, measurements of this flux are desired. However, calculated values are useable, and methods of such calculation are discussed. Author

N65-35246*# National Aeronautics and Space Administration, Washington, D. C.
RADIATION ENVIRONMENT IN SPACE
J. Warren Keller [1964] 36 p refs Presented at Inst. of Environ. Sci. Symp., Ann Arbor, Mich., 26 Feb. 1964
(NASA-TM-X-51568) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The important components (for space vehicle design) of the indigenous radiation fields in space, including galactic cosmic radiation, solar cosmic radiation (solar protons); and the geomagnetically trapped radiation from natural origin and from the July 1962 high altitude nuclear detonation are under study. It was concluded that solar cosmic radiation was the dominating radiation environment for deep space vehicles which traverse the trapped radiation belts rapidly, and is not completely defined or understood. It was stated that the major radiation effects problems from the indigenous radiations in space were with items on or near the surface of the vehicles. R.W.H.

N65-35589# Oslo Univ., Blindern (Norway). Inst. of Theoretical Astrophysics.
SOLAR RADIO NOISE REGISTRATIONS AT THE OSLO SOLAR OBSERVATORY, 1960–1964 Scientific Report No. 7(56)
Oystein Elgaroy 1965 87 p refs Repr. of Rept.-16
(Contract AF 61(052)-743)
(AFCRL-65-366; AD-617566)

The observational data from the period 1960 to 1964 are presented. The method of tabulation is described, and the measurements are compared with those of some other observatories. The characteristics tabulated are: median flux density, variability, and outstanding occurrences. R.W.H.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-34829 Johns Hopkins Univ., Baltimore, Md. Lab. of Astrophysics and Physical Meteorology.
WATER IN THE ATMOSPHERES OF PLANETS
John Strong *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 337–339 refs (See N65-34804 23-20)

The amount of water vapor present above the reflective cloud layer on the planet Venus was determined with an automatic telescope of 30-cm aperture carried by balloon to 26.5 km. The band at 1.13μ was scanned once every 10 seconds with a set of 21 exit slits arrayed to match 21 H_2O absorption line groups. The radiation was measured with a grating spectrometer of 2-Å resolving power and as the radiation passed through a chilled photomultiplier with S-1 surface its response was recorded. The modulation produced by the water absorption was 10.5 ±0.5 percent; the same as produced by 9.8×10^{-3} g/cm^2 of water vapor at atmospheric pressure. The influence of water vapor in the earth's atmosphere above the balloon and the influence of the Doppler shift on the recorded data were assessed. The amounts of water vapor calculated for gravitational atmospheres at various pressures are 22.2×10^{-3} g/cm^2 for the 90-mb case, and 5.2×10^{-3} g/cm^2 as for the 600-mb case. The respective mixing ratios are 2.5×10^{-4} and 0.87×10^{-5}. M.R.W.

N65-34835 Observatoire de Paris (France). Section d'Astrophysique.
DETECTION OF WATER VAPOR IN THE ATMOSPHERES OF VENUS AND MARS
Audouin Dollfus *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 409–417 refs (See N65-34804 23-20)

Balloon flights for the detection and measurement of water vapor in the atmosphere of Venus and Mars are discussed. A lightweight sealed cabin, and telescopic and spectroscopic devices used to record the measurements are described. Two lifting devices are mentioned. One type is composed of a cluster of 104 dilatable sounding balloons organized in 34 groups of three balloons, one above the other, along a vertical cable 1400 feet long. The second device uses a chaplet-like cluster of 23 neoprene Darex 7000-gram balloons capable of ascents to 80 000 feet. An observation was made from a high mountain site to determine, for calibration purposes, the amount of water vapor contributed by the earth's atmosphere. Reduction of data, including minor corrections and

recalibration, yielded the following water vapor values: for Venus, 0.7 × 10^{-2} g/cm^2, and for Mars, 1.5 × 10^{-2} g/cm^2. M.R.W.

N65-34875# Joint Publications Research Service, Washington, D. C.
RECENT DEVELOPMENTS IN SOVIET ASTROPHYSICS
14 Sep. 1965 12 p Transl. into ENGLISH of 3 articles from Vestn. Akad. Nauk SSSR (Moscow), no. 6, Jun. 1965 p 94–95, 103–105, 114–117
(JPRS-31997; TT-65-32491) CFSTI: $1.00

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1. CONFERENCE OF OBSERVERS OF ARTIFICIAL EARTH SATELLITES T. V. Kasimenko and M. A. Lur'e p 1–3
2. RADIATION BELTS AND COSMIC RAYS G. B. Zhdanov p 4–6
3. NOTES FROM THE ASTRONOMY COUNCIL CONFERENCE E. P. Aksenov and V. V. Ivanov p 7–10

N65-34880# Princeton Univ., N. J. Dept. of Physics.
EXPERIMENTAL AND THEORETICAL INVESTIGATION OF GRAVITATION Status Report
R. H. Dicke 10 Jun. 1965 15 p refs
(Contract Nonr-1858(30))
(AD-618703)

The principle research activities involved in this study are: solar oblateness experiment, the earth's rotation, solar eclipses, isostatic rebound, pendulum, hot universe, helium formations, stability and galaxy formation, 3 cm radiometer, X-ray stars, cosmology and infrared from distant galaxies, and the solar oblateness theory. R.W.H.

N65-34923# Royal Observatory, Edinburgh (Scotland).
THE CYGNUS II ASSOCIATION. I: INTERCOMPARISON OF PHOTOMETRIES WITH THE EDINBURGH AND HAMBURG SCHMIDT TELESCOPES
L. C. Lawrence and V. C. Reddish HMSO, 1965 33 p refs *Its* Publ. Vol. III, No. 9 CFSTI: HC $2.00/MF $0.50

Photographic UBV photometry of the association Cygnus II and the nearby cluster NGC 6910, using the Hamburg 80/120 cm. Schmidt telescope, showed systematic differences from the published photoelectric magnitudes used for calibration purposes. The photographic photometry was therefore repeated at Edinburgh using the 40/60 cm. Schmidt telescope. The results agreed well with the Hamburg photographic photometry, confirming the discrepancies between the photographic and published photoelectric photometries. No source of error could be found in the photographic photometry large enough to account for the discrepancies. The coming into operation of the twin 16-inch photoelectric telescope at Edinburgh enabled the photoelectric magnitudes to be remeasured; the results showed that the discrepancies had been due to errors in the published photoelectric magnitudes. In respect both of transfer of zero point across the field, and internal random errors, the photographic photometry using the Schmidt telescopes has proved to be superior to most of the published photoelectric photometry in the area. Author

N65-34925# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COSMIC RESEARCH, VOLUME 3, NO. 3
18 Aug. 1965 276 p refs Transl. into ENGLISH of the book "Kosmicheskiye Issledovaniya, Tom III, Vypusk 3" Moscow, Izd. Nauka, 1965 p 347–504
(FTD-TT-65-828/1+2; AD-619986)

Research on space vehicle trajectories and orientation in gravitational fields, measurement of atmospheric density and radiation, and the influence of spaceflight on bacteria and plantlife is reported. For individual titles see N65-34926–N65-34947.

N65-34926 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE MOTION OF A SOLID BODY IN A NEWTONIAN CENTRAL FORCE FIELD
A. I. Lur'ye *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 1–6 refs (See N65-34925 23-30)

A procedure is given for determining the perturbation of the Keplerian orbit of the body's center of inertia, based on the assumption that the rotation of the body (angular velocity vector, Euler angles) is known. The problem is reduced to quadratures, and the solutions are presented. M.G.J.

N65-34927 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONCERNING ONE FORM OF THE EQUATIONS OF MOTION OF A MATERIAL POINT IN THE EARTH'S GRAVITATIONAL FIELD
A. I. Lur'ye *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 7–11 refs (See N65-34925 23-30)

In determining the motion of a material point in the earth's gravitational field, the problem is examined directly using the spherical coordinate system, and with little importance given to perturbations of the orbit elliptical elements. In the method described, the problem is reduced to a system of two second-order differential equations which are accessible to analysis by the averaging method and possible modifications of it. M.G.J.

N65-34928 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF ERRORS IN THE MASS DISTRIBUTION OF A SPACE VEHICLE ON ACCURACY OF ORIENTATION
Ye. N. Tokar' *In its* Cosmic Res., Vol. 3, No. 3, 18 Aug. 1965 p 12–21 (See N65-34925 23-30)

The problem of calculating the errors of orientation of a space vehicle due to deviations of its principal central axes of inertia from the axes to be oriented is examined. The method suggested permits, in many cases, shortening of the procedure for calculating these errors and it has as its principal advantage the possibility of using the equations of motion of the space vehicle in the projections onto the axes to be oriented, written without consideration of the centrifugal moments of inertia of the vehicle about these axes. The concept of negative mechanical mass in the dynamic sense and the concept of a composite solid body composed of positive and negative mass elements are introduced in the process of validating this approach. Author

N65-34929 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF CONSTRUCTING SOLUTIONS TO THE EQUATIONS OF PLANE UNPERTURBED MOTION IN CELESTIAL MECHANICS
V. V. Laricheva and M. V. Reyn *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 22–34 refs (See N65-34925 23-30)

Approximate general solutions are found for a number of perturbed systems by use of a theory set forth earlier [1]. The problem of selecting the control disturbance that results in stable motion of a point along an assigned spiral trajectory is solved. The class of perturbed systems having logarithmic spirals as particular solutions is studied in detail. Author

N65-34930 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OPTIMUM TRAJECTORIES OF A REACTION VEHICLE IN A CENTRAL FIELD

V. I. Gurman *In its* Cosmic Res., Vol. 3, No. 3, 18 Aug. 1965 p 35–44 refs (See N65-34925 23-30)

The method of V. F. Krotov is applied to investigate the general problem of finding optimum motion regimes for a point of variable mass in a central field in the case in which the final point in time is not assigned and the energy of the point is negative. It is shown that the degenerate variational problem under consideration can be reduced entirely to some nondegenerate problem for a system of differential equations in the osculating elements of lower order than the original, one in which the role of the controls is taken by the steering thrust vector and the crew anomaly of the point on the osculating orbit. In the general case, the solution of the original problem is a minimizing sequence each of whose elements is constructed according to the following rule: the expenditure of mass must take place in the optimum direction and in the neighborhood of the optimum position on the osculating orbit. Here the thrust level may be arbitrary. Author

N65-34931 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF PARTIAL DERIVATIVES OF THE CHARACTERISTICS OF MOTION FROM THE INITIAL CONDITIONS

V. G. Khoroshavtsev *In its* Cosmic Res., Vol. 3, No. 3, 18 Aug. 1965 p 45–52 ref (See N65-34925 23-30)

A simplified algorithm is given for calculating the values of partial derivatives of the parameters of a satellite's motion from the initial conditions. The algorithm can be employed in problems concerned with determination of artificial earth-satellite orbits, estimating the error of the determination, and a number of others. Author

N65-34932 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PROBLEMS IN THE PREDICTION OF SPACE-VEHICLE MOTION ABOUT THE CENTER OF MASS

V. N. Borovenko *In its* Cosmic Res., Vol. 3, No. 3, 18 Aug. 1965 p 53–68 refs (See N65-34925 23-30)

The coordinates L_1, ρ_1, σ_1 are introduced to permit graphic geometrical description of the motion of the kinetic-moment vector in the attached axes. The motion of the kinetic-moment vector $\vec{L_1}$ in the axes Oxyz, which are attached to the apparatus, is investigated under the influence of perturbations of chiefly internal nature (dynamic asymmetry, flywheels, liquid damping and constant perturbing moments). It is shown that the dynamic asymmetry of the vehicle, flywheels with constant angular velocity of rotation, and even the constant perturbing moments acting in a plane perpendicular to the axis of fast rotation do not give rise to secular motion of the vector $\vec{L_1}$. Applying the averaged equations of motion, we obtain finite calculation formulas for the secular motion of vector $\vec{L_1}$ due to the fluid charges in certain chambers inside the vehicle and a constant perturbing moment acting on the axis of fast rotation. This is followed by qualitative analysis of the possible locus paths of the kinetic moment vector $\vec{L_1}$ on the unit sphere in the Oxyz system. Author

N65-34933 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RADIATION ORIENTATION OF SPACE VEHICLES

E. B. Galitskaya and M. I. Kiselev *In its* Cosmic Res., Vol. 3, No. 3 18 Aug. 1965 p 69–75 refs (See N65-34925 23-30)

The paper discusses a scheme for controlling the motion of a space vehicle about its center of mass with respect to three axes, using the pressure of solar radiation. The maximum efficiency in utilizing the solar radiation pressure and the optimum vane inclination for generation of torque are determined. It is found that "radiation precession" of the object takes place when the light falls unsymmetrically on the control-blade system. Author

N65-34934 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE PHYSICAL PROPERTIES OF THE LUNAR SURFACE

Ye. L. Ruskol *In its* Cosmic Res., Vol. 3, No. 3 18 Aug 1965 p 76–103 refs (See N65-34925 23-30)

Results of investigations into properties of the lunar surface, conducted during the past two–three years, are reviewed. Data are presented on the characteristics of the lunar surface, averaged over the entire disk of the moon, as well as on local nonuniformities. Results of laboratory simulation of lunar surface conditions are described. The paper examines the relationship between the data on the thermal regime of the upper lunar layers and the problem of the escape of gases from beneath the lunar surface and the history of the lunar atmosphere. Author

N65-35018# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE EQUIVALENT WIDTHS OF ABSORPTION LINES IN THE SPECTRA OF 109 05–B7 STARS Astronomical Papers Translated from the Russian, No. 4

I. M. Kopylov 13 Jul. 1965 45 p refs Transl. into ENGLISH from Ann. of the Crimean Astrophys. Obs. (USSR), v. 20, 1958 p 123–155

Seven hundred and sixty spectrograms, with a dispersion of 75 Å/mm at H, were taken for 109 stars of the 05-B7 classification. Measurements were made with the large spectrograph of the 1220-mm reflector at the Crimean Astrophysical Observatory. Equivalent widths were determined in the λλ 3700 to 5000 Å interval for all the absorption lines of hydrogen and helium and for the most intense lines of calcium, carbon, magnesium, nitrogen, oxygen, and silicon. Data on derived mean equivalent widths are presented, and a comparison of these and previously published results provides the basis for a system of equivalent widths. These results indicate that spectrograms of stars with a dispersion of about 30 to 70 Å/mm can be used to determine equivalent widths with sufficient accuracy for a number of astrophysical problems. The derived equivalent widths of absorption lines can be used to carry out a two-dimensional quantitative spectral classification of 05-B7 stars. M.W.R.

N65-35019# Smithsonian Astrophysical Observatory, Cambridge, Mass.

ON THE THEORY OF STELLAR VARIABILITY. IV: ON THE ROLE OF CONVECTION Astronomical Papers Translated from the Russian, No. 6

S. A. Zhevakin 4 Aug. 1965 32 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 32, 1955 p 124–138

It appears that the ionized zone which occurs in convective equilibrium is not in a condition to maintain auto-oscillations of the star. This leads us to conclude that in variable stars radiative equilibrium exists in the zone of critical He II ionization (regardless of the presence of convection). This conclusion is supported by estimates of stationary values of convective and radiative density of energy flux, in the zone of critical double ionization of helium in supergiant stars. These estimates show that the convective transfer of energy there must be negligibly small compared with the radiative transfer. We conclude that the necessary condition for the occurrence of stellar variability is that convective transfer should be small compared with radiative transfer in the ionized zone of the star. Main sequence stars and subdwarfs, in which this condition is not satisfied, cannot pulsate. Author

N65-35023# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

USE OF SINGLE-AXIS ORIENTATION FOR ARTIFICIAL EARTH SATELLITES

R. F. Appazov, V. P. Legostayev, and B. V. Raushenbakh 15 Jun. 1965 23 p Transl. into ENGLISH from Russian
(FTD-MT-65-181; AD-619314)

It is assumed that the axis coincides with the direction of jet thrust of the engine, intended for transition to the descent orbit. The system consists of a photo-electric sensor, three two-degree-of-freedom gyroscopes, reacting to the corresponding projections of angular velocity the vehicle and a logic unit, and actuators (small jet engines). The photoelectric pickoff (solar sensor) reacts only to turns of the ship (with respect to the direction to the sun). TAB

N65-35024*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.

ORBIT SELECTION STUDY FOR PAGEOS SATELLITE Summary Report

S. Worley, J. Miller, and G. Linsenmayer [1965] 31 p
(Contract NAS1-4614)
(NASA-CR-66006) CFSTI: HC $2.00/MF $0.50 CSCL 22C

Six promising orbits were investigated in terms of the relative number of viewing opportunities provided to a representative seven-station network, using a time sample of one month in three. It was noted during this selection that all orbits appeared to give satisfactory viewing opportunities, with small variations from orbit to orbit. A complete five-year run using the selected orbit showed that it met all observation requirements, and that the results of the short run agreed reasonably well with those of the complete run. An investigation of variations in the launch characteristics, in terms of the resulting maximum eccentricity attained by the orbit during a five-year period, revealed only slight changes for initial eccentricities of 0.02, for altitude variations of ±100 km, and for inclination variations of ±1 degree. R.W.H.

N65-35052# Royal Greenwich Observatory, Herstmonceux (England).

PROPER MOTIONS AND RADIAL VELOCITIES OF HYADES STARS

P. A. Wayman, L. S. T. Symms, and K. C. Blackwell London, HMSO, 1965 32 p refs *Its* Bull. No. 98 CFSTI: HC $2.00/MF $0.50

Proper motions and radial velocities of stars of the Hyades cluster are studied for a determination of the cluster motion, and stars of known radial velocity in an extended region of the sky around the cluster are examined for possible cluster membership. Particular attention is paid to the accuracy of the data and the residuals of the solution. From these residuals in both proper motion and radial velocity it is possible to estimate an upper limit for the intrinsic velocity dispersion of about 0.5 km/s. There is little evidence for a significant systematic rotation of the cluster with respect to standard frames of reference. It is shown that a small rotation of this kind will not affect the zero-point of absolute magnitude derived from cluster parallaxes for the Hyades stars, but there may be a small random contribution to the absolute magnitudes of individual stars. Of the 132 Hyades-cluster members listed by van Bueren in 1952 the data collected in this paper indicate that two are probably not cluster members and the investigation of 99 other stars of known radial velocity indicates that about 14 of these stars probably are members. Author

N65-35053# Royal Greenwich Observatory, Herstmonceux (England).

PHOTOMETRY OF THE CLUSTER NGC 6522

S. V. M. Clube London, HMSO, 1965 28 p refs *Its* Bull. No. 95 CFSTI: HC $2.00/MF $0.50

The determination of the color-magnitude diagram of NGC 6522 for stars brighter than $V = 17^m.0$, $B = 18^m.5$ is described. At least six short period variables are identified as cluster members and, from their mean color, a figure for the visual absorption in front of the cluster is obtained. Although a value of 8.51 kpc is obtained for the distance of the cluster, the uncertain features in its determination are emphasized. These uncertainties are of considerable importance in discussing the distance to the galactic center. Author

N65-35074*# National Aeronautics and Space Administration, Washington, D. C.

COSMIC DUST: RECENT RESEARCH AT THE FRENCH ATOMIC ENERGY COMMISSION [LES POUSSIERES COSMIQUES: RECHERCHES RECENT AU C.E.A.]

T. Grjébine Sep. 1965 26 p Transl. into ENGLISH from Bull. Inform. Sci. Tech. Comm. Energie Atomique (France), no. 89, 1965 p 1–15
(NASA-TT-F-9576) CFSTI: HC $2.00/MF $0.50 CSCL 03B

Theories on the origin of cosmic dust are reviewed. The probability of atmospheric, industrial, desert sand and other pollution, contribution by volcanic ash, tropospheric or stratospheric hemogenization, is eliminated by logical deductions, to prove that the large amounts of dust accretion on land and in marine sediments must be of extraterrestrial (cometary or meteoric) origin. The capture of dust from the toroidal meteor group by the earth, due to difference in form of their orbits, is theorized. An attempt is made to attribute the motion of the earth in space, the appearance of meteors in the atmosphere, and the fallout of radioactive debris to one and the same phenomenon, namely, to an entrainment by magnetic dusts. A table is given for defining the possible origins of dust fallouts by eliminating improbable sources. Author

N65-35078# Ohio State Univ., Columbus.

VARIATIONS IN THE SPECTRUM OF 56 ARIETIS

William Arthur Wallace (M.S. Thesis) 1965 78 p refs Sponsored by AF
(AD-618699)

The question of whether or not the variations in intensity of spectrum variables are strictly periodic and stable over long periods of time is discussed. The star 56 Arietis affords one test of this question because of its exceptionally short period of variation and the availability of previous data. An attempt

was made to investigate the intensity variation of the HeI lines and the SiII lines. The strengths of H epsilon and H gamma were investigated in order to ascertain if short period fluctuations in equivalent width of an angstrom or more occur in 56 Arietis. TAB

N65-35084# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

TIME HISTORY OF THE MOTION AND STABILITY OF A DUMBBELL SATELLITE IN ORBIT ABOUT A SPHERICAL, ROTATING EARTH

Donald W. Fresh (M.S. Thesis) Jun. 1965 98 p refs
(GAM/MECH/65B-6; AD-618728)

The general three-dimensional equations of motion are derived for an unsymmetrical dumbbell satellite with masses connected by an infinitely rigid, weightless bar. The satellite is spun about its center of mass at a rate sufficient to create an artificial one "g" environment at the larger mass. The equations of motion are modified using a small perturbation approach to separate the motion of the vehicle from that of an equivalent point mass. Solution of the resulting perturbation equations is accomplished using the IBM 7090-94 Digital Computer System. Results predict a stable orbit and an essentially constant satellite spin rate vector. Author

N65-35111*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

CATALOG OF PRECISELY REDUCED SIMULTANEOUS OBSERVATIONS, NO. S-1

Richard Wells 14 Sep. 1965 276 p refs
(Contract NsG-87-60)
(NASA-CR-67252; SAO Special Rept.-183) CFSTI: HC $6.00/MF $1.50 CSCL 22C

A catalog is presented which lists the position of artificial satellites photographed simultaneously by cameras at two or more stations. Included are all simultaneous observations precisely reduced that have been checked and found to be without significant errors. The criterion of simultaneity is a minimum of 4 seconds (in time) overlap in the observed arc of each photographing station. In terms of position, each simultaneous arc has at least one overlapping precisely reduced position. The catalog lists in columns the year, month, and day of the observation; the time of the observation; the root mean-square (standard error) of the time expressed in milliseconds; the topocentric right ascension; the topocentric declination; the standard error (RMS) of the position expressed in seconds of arc; and the station number. C.T.C.

N65-35121*# Geophysics Corp. of America, Bedford, Mass. Technology Div.

PLANETARY METEOROLOGY Quarterly Progress Report No. 1, 21 Mar.–30 Jun. 1965

20 Jul. 1965 61 p refs
(Contract NASw-1227)
(NASA-CR-67296) CFSTI: HC $3.00/MF $0.75 CSCL 03B

Theoretical models were developed for determining the seasonal and latitudinal variations of surface temperature and mean atmospheric temperature. In one model the surface and mean atmospheric temperatures are computed from conditions of radiative equilibrium. In a second model the effect of the meridional transport of heat by the atmosphere is included in the computations of the Martian temperature climate. In other meteorological studies on Mars, the diurnal variation of the surface temperature; and interhemispheric transport of water vapor with respect to Martian ice-caps were studied; and zonal wind velocities on Mars and Earth were compared. In meteorological studies on Venus, atmospheric circulation in the Venusian atmosphere, and the composition of Venusian clouds are discussed. L.S.

N65-35200*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A STAR FIELD MAPPING SYSTEM FOR DETERMINING THE ATTITUDE OF A SPINNING PROBE

Robert L. Kenimer and Thomas M. Walsh [1964] 21 p refs Presented at the Aerospace Electro-Technol. Symp. of the Intern. Conf. and Exhibit on Aerospace Electro-Technol., Phoenix, Ariz., 19–25 Apr. 1964
(NASA-TM-X-54538) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Star mapping is accomplished by optically scanning a band of the star field about the vehicle's equator. Determination of the orientation of the vehicle's spin axis and roll angle to the celestial sphere is accomplished by cross correlation of the scanned star map with a known reference map of the celestial sphere. This paper includes a description of the star mapping system configuration and environment. System performance is discussed from the viewpoint of parameters which limit performance characteristics of the system. A typical design is considered and estimated performance characteristics are presented. Author

N65-35217*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

REENTRY

E. Brian Pritchard [1963] 61 p refs Presented at the Inter-Am. Inst. for Space Sci. Education, 1963 Summer Conf. for Sci. Teachers
(NASA-TM-X-54614) CFSTI: HC $3.00/MF $0.75 CSCL 22A

The major problems in reentry deceleration loads, corridor width, range control, and heating loads are discussed. The effects of reentry vehicle L/D capability, initial reentry velocity, and atmospheric maneuvers on these problems are demonstrated. The complexities of designing a reentry vehicle are pointed out. The effect of increased L/D capability is shown to be advantageous from the standpoint of corridor width, deceleration loads, and range control, but most disadvantageous from the standpoint of aerodynamic heating. The role played by vehicle nose shape in reentry is demonstrated by the opposing effects of convective and radiative heating. The necessity for a vehicle to have the capability of maneuvering within the atmosphere is shown. The effect of initial reentry velocity indicates that in all probability a specific reentry vehicle must be defined for each space mission or reentry velocity range. C.T.C.

N65-35233*# National Aeronautics and Space Administration, Goddard Inst. for Space Studies, New York.

PARTICLE ACCELERATION IN CISLUNAR SPACE

A. G. W. Cameron [1964] 7 p refs Submitted for Publication
(NASA-TM-X-51610) CFSTI: HC $1.00/MF $0.50 CSCL 03B

It is suggested that a further alternative mechanism be required in which lunar bombardments would involve particles of energy greater than those of the solar wind which were accelerated and trapped by the chaotic magnetic field configuration then existing in interplanetary space. A recent analysis of terrestrial magnetic activity has shown that the general level of activity had changed for several days on either side of the moon, suggesting that the antisolar magnetic cavity may extend to the lunar distance. Other theories concerning the phenomenon were reviewed, and it was suggested that the luminescence near the crater Kepler may have been produced by energetic particle streams; it may also have been

produced by trapped radiation in the distant tail of the magnetosphere. It was pointed out that due to the localized nature of the incident particle streams, lunar luminescence excited in this way is likely to be observed only in small regions of the moon, and to exhibit variations within periods of a few minutes. R.W.H.

N65-35245*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRAJECTORY AND RENDEZVOUS ASPECTS OF MANNED LUNAR LANDINGS

Laurence W. Enderson, Jr. and William H. Michael, Jr. [1964] 29 p Presented at the 1st Canaveral Space Congr., Cocoa Beach, Fla., 20–22 Apr. 1964

(NASA-TM-X-51567) CFSTI: HC $2.00/MF $0.50 CSCL 22C

The results of some current research on problems of manned lunar exploration associated with the Lunar Orbit Rendezvous technique are presented. A typical mission profile is selected and consideration is given to the interrelationships and requirements of each phase of the overall mission. Landing sites on the surface of the moon are defined in view of overall mission requirements and crew safety. It is shown that landing sites in the lunar equatorial region, which are established from low inclination lunar orbits, provide reasonably long exploration times and satisfy the trajectory and rendezvous requirements. Author

N65-35289*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.

THE COOLING RATES AND PARENT PLANETS OF SEVERAL IRON METEORITES

John A. Wood [1964] 86 p refs Submitted for Publication

(Grants NsG-366; NSF G-14298)

(NASA-CR-58417; EFINS-64-43) CFSTI: HC $3.00/MF $0.75 CSCL 03B

Theories on the formation of the Widmanstätten structure are reviewed, and inconsistencies between the various interpretations are examined. Based on the concept that this structure could be understood quantitatively as the result of solid-state transformations occurring in slowly cooling Ni–Fe alloys, 11 octahedrites and 3 nickel-rich ataxites were studied. Electron probe profiles were made of the characteristic Ni diffusion gradients in taenite–plessite regions of the octahedrites, and a digital computer program was used to generate artificial diffusion gradients by solving the equation for diffusion of Ni in γ alloys under differing circumstances. Comparisons of computed and measured structures showed that most cooled to ~100°C beneath the $\gamma/(\alpha + \gamma)$ boundary before Widmanstätten structure was precipitated. A correlation between cooling rates, structural types, and probably Ga–Ge groups appears to exist. Studies of the Ni-rich ataxites indicate scattered kamacite crystals under circumstances of very rapid cooling, excessive supercooling, or both. M.G.J.

N65-35302*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EARTH–MARS TRAJECTORIES, 1971, VOLUME 4, PART A

R. J. Richard and R. Y. Roth 15 Jun. 1965 755 p refs

(Contract NAS7-100)

(NASA-CR-67357; JPL-TM-33-100) CFSTI: HC $10.55/MF $3.50 CSCL 22C

Machine computations of three-dimensional ballistic interplanetary trajectories are presented. The analytic model used to represent these trajectories is based on two-body, inverse-square, force field mechanics. A brief explanation of the model is included. Basically, the trajectories are calculated in two distinct parts: (1) the heliocentric transfer ellipse and (2) the launch-planet-centered escape trajectories. Differential corrections, and guidance and tracking parameters are given. C.T.C.

N65-35303*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EARTH–MARS TRAJECTORIES, 1971, VOLUME 4, PART B

R. J. Richard and R. Y. Roth 15 Jun. 1965 753 p refs For abstract see N65-35302

(Contract NAS7-100)

(NASA-CR-67358; JPL-TM-33-100) CFSTI: HC $10.53/MF $3.50 CSCL 22C

N65-35304*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EARTH–MARS TRAJECTORIES, 1971, VOLUME 4, PART C

R. J. Richard and R. Y. Roth 15 Jun. 1965 785 p refs For abstract see N65-35302

(Contract NAS7-100)

(NASA-CR-67359; JPL-TM-33-100, Vol. 4, Pt. C) CFSTI: HC $10.58/MF $3.50 CSCL 22C

N65-35305*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EARTH–MARS TRAJECTORIES, 1971, VOLUME 4, PART D

R. J. Richard and R. V. Roth 15 Jun. 1965 756 p refs For abstract see N65-35302

(Contract NAS7-100)

(NASA-CR-67360; JPL-TM-33-100, Vol. 4, Pt. D) CFSTI: HC $10.56/MF $3.50 CSCL 22C

N65-35306*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EARTH–MARS TRAJECTORIES, 1973, VOLUME 5, PART A

R. J. Richard and R. Y. Roth 15 Jun. 1965 811 p refs For abstract see N65-35302

(Contract NAS7-100)

(NASA-CR-67361; JPL-TM-33-100, Vol. 5, Pt. A) CFSTI: HC $11.11/MF $4.00 CSCL 22C

N65-35307*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EARTH–MARS TRAJECTORIES, 1973, VOLUME 5, PART B

R. J. Richard and R. Y. Roth 15 Jun. 1965 812 p refs For abstract see N65-35302

(Contract NAS7-100)

(NASA-CR-67362, JPL-TM-33-100, Vol. 5, Pt. B) CFSTI: HC $11.12/MF $4.00 CSCL 22C

N65-35308*# Jet Propulsion Lab., Calif., Inst. of Tech., Pasadena.

EARTH–MARS TRAJECTORIES, 1973, VOLUME 5, PART C

R. J. Richard and R. Y. Roth 15 Jun. 1965 809 p refs For abstract see N65-35302

(Contract NAS7-100)

(NASA-CR-67363; JPL-TM-33-100, Vol. 5, Pt.-c) CFSTI: HC $11.09/MF $4.00 CSCL 22C

N65-35388*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ORBIT SELECTION STUDY FOR PAGEOS SATELLITE Final Report
S. Worley, J. Miller, and G. Linsenmayer May 1965 173 p (Contract NAS1-4614)
(NASA-CR-66007) CFSTI: HC $5.00/MF $1.00 CSCL 22C

An investigation was made to select a suitable orbit for the Pageos geodetic satellite program. Selection was based on obtaining a maximum number of satisfactory observation opportunities, subject to certain initial orbit constraints. The final report contains a complete discussion of all factors involved in the selection, and a discussion of the characteristics of the selected orbit. Author

N65-35399# Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
PHYSICS OF THE INTERPLANETARY MEDIUM [FISICA DEL ESPACIO INTERPLANETARIO]
W. R. Webber (Minnesota Univ.) 1965 46 p refs (CNIE-PE-5) CFSTI: HC $2.00/MF $0.50

A course in interplanetary physics is presented which covers the experimental evidence about interplanetary space, theoretical models which explain the observed characteristics of the interplanetary medium, experimental evidence concerning cosmic radiations, and theoretical models to explain these cosmic ray variations in terms of the interplanetary medium. The Debye length, mean free path of electron and protons, electrical conductivity, and thermal conductivity are discussed in the summary of general properties and characteristics of the interplanetary medium as inferred from experimental measurements. Also, the quiet medium, coronal expansion, the effects of centrifugal force and magnetic fields on the motion of the solar plasma, interplanetary plasma outside the Earth orbit and its interaction with the interstellar medium, and irregularities in the medium are considered for the solar corona. Time variation of the galactic cosmic rays, Forbush decreases, the diurnal variation, time variation of the solar cosmic rays, and the role of cosmic rays in the interplanetary medium are also considered. E.E.B.

N65-35405* Chicago Univ., Ill.
CHEMICAL FRACTIONATIONS IN METEORITES
Edward Anders Washington, NASA, Sep. 1965 24 p refs (Grant NsG-366)
(NASA-CR-299) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Presented is a discussion on chemical fractionations in meteorites which focuses on inherent problems associated with the acceptance of chondrites as average samples of nonvolatile planetary matter. In view of unsuccessful attempts to find a single set of chemical and physical conditions that were consistent with the abundance pattern in chondrites, it was assumed that meteoritic matter is derived from two materials of contrasting chemical history. Proposed is a simple model which assumes that the meteorites and planets are a blend of two types of material: an undepleted fraction rich in volatiles, and a depleted fraction from which the volatiles were lost. Included is an analysis of existing theories on the origin of meteorites which support the concept of the dual origin of meteoritic matter. S.C.W.

N65-35414*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INJECTION ACCURACY CHARACTERISTICS FOR LUNAR MISSIONS
T. H. Thornton, Jr. 15 Oct. 1965 10 p refs (Contract NAS7-100)
(NASA-CR-67351; JPL-TR-32-839) CFSTI: HC $1.00/MF $0.50 CSCL 22C

This report investigates a technique for expressing launch vehicle injection accuracy in terms of spacecraft midcourse correction requirements for Earth–Moon missions. A figure-of-merit is defined which can be used as a measure of injection accuracy. The variables important to guidance accuracy such as injection energy, launch azimuth, lunar declination, and Earth–Moon distance are discussed. A best target coordinate system is developed, and numerical results which enable the engineer to relate launch vehicle injection accuracy to spacecraft midcourse correction requirements are presented. Both miss-only type midcourse corrections, and miss-plus-time corrections are considered. Author

N65-35472# Kyoto Univ. (Japan). Inst. of Astrophysics.
EFFECT OF THE ULTRAVIOLET RADIATION ON THE IONIZATION AND EXCITATION OF MATTER IN PROMINENCES. I: EFFECT OF THE LYMAN CONTINUOUS RADIATION ON HYDROGEN ATOMS
Ichiro Kawaguchi 1964 19 p refs *Its* Contribution No. 134 CFSTI: HC $1.00/MF $0.50

Effect of the Lyman continuous radiation in the transition layer between the chromosphere and corona on the ionization of hydrogen is discussed. An idealized hydrogen model is used with three discrete and one continuous levels. The main sink of the Lyman continuous radiation is due to collisional de-excitation from the first excited level to the ground level. When $N_e < 10^{12}$ cm^{-3}, the Lyman continuous radiation penetrates diffusely into the prominence matter. Furthermore, if the kinetic temperature in the prominence is higher than 8000° K, the incident ultraviolet radiation is not effective to the ionization of hydrogen. For several cases of model prominences with uniform density and constant temperature, the transfer equation for the Lyman continuous radiation is solved numerically. With reference to the ionization of hydrogen, a prominence consists of two zones. In the outer zone, hydrogen is ionized by the diffusely scattered radiation of the incident ultraviolet continuous spectrum, and in the inner zone, the ionization of hydrogen can be calculated by the Pottasch-Thomas formula. Author

N65-35490* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO MISSION PROFILE
J. J. Donegan *In its* Proc. of the Apollo Unified S-Band Tech. Conf. p 135–144 (See N65-35476 23-07) CFSTI: HC $3.00/MF $1.50

A typical Apollo mission profile is presented to provide an understanding of the tracking requirements placed on the Unified S-band System in support of the Apollo mission. Characteristics of the Apollo spacecraft are included, as well as the timing sequence of the Apollo spacecraft events from initial liftoff through lunar touchdown, lunar liftoff, reentry, and earth touchdown. Orbital parameters, flight constraints, and navigational problems are also discussed. Author

N65-35554# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
PLANE-CHANGE REQUIREMENTS ASSOCIATED WITH RENDEZVOUS IN A SATELLITE ORBIT ABOUT MARS
Randolph M. Teaque (M.S. Thesis) Jun. 1965 115 p refs (GGC/EE/65-16; AD-619395)

The purpose of this thesis is to determine the plane-change requirements associated with rendezvous in a satellite orbit about Mars. The geometry of the landing and rendezvous is first worked out along with derivations of appropriate equations. The effect of satellite orbit perturbations is investigated with planet oblateness having the only noticeable influence for short staytimes on Mars. The requirement of maintaining rendezvous capability at all times while on the planet surface was studied, with the results appearing as a graph from which the minimum-maximum plane-change angle can be obtained for all staytimes, landing latitudes, and orbit angles. Author

N65-35555# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SECOND GROUP SPACE FLIGHT, AND CERTAIN RESULTS OF FLIGHTS OF SOVIET COSMONAUTS ON THE "VOSTOK" SHIPS
A. D. Voskrensenskiy, O. G. Gazenko, and D. G. Maksimov, comp. Moscow, Izd. Nauka, 1965 196 p refs Transl. into ENGLISH of the book "Vtoroy Gruppovoy Kosmicheskiy Polet. i Nekotoryye Itogi Poletov Sovetskikh Kosmonavtov na Korabyakh 'Vostok'"
(FTD-MT-65-256; AD-619384)

Reports are presented on general conditions of flight and flight assignment; physiological-hygienic appraisal of the life-support systems and safety measures; air regeneration and conditions in the cabins of ship-satellites; hygienic appraisal of clothes donned under pressure suit; feeding and water supply; medical control of physical preparation of cosmonauts; investigation with creation of brief weightlessness on an aircraft; investigations on a centrifuge; investigation of vestibular reactions; influence of high temperatures; psychological investigations in conditions of isolation; working activity of the cosmonauts; results of investigations in flight; postflight medical inspection of cosmonauts. TAB

N65-35578*# Alaska Univ., College. Geophysical Inst.
RADIO-STAR VISIBILITY FADES OBSERVED IN THE AURORAL ZONE, PART I Scientific Report No. 1
Edward J. Fremouw Apr. 1963 87 p refs
(Contract NAS5-1413)
(NASA-CR-67372; UAG-R134) CFSTI: HC $3.00/MF $0.75 CSCL 03A

The operation of a phase-switch interferometer is analyzed to show that reductions in output may be interpreted as reductions in correlation between signals arriving at the two antennas. Visibility fades of the radio stars Cygnus A and Cassiopeia A, observed on 223 megacycles in the auroral zone during one year of maximum sunspot activity, are analyzed empirically. Fade-occurrence distributions in time and space are presented and comparisons with certain other geophysical phenomena are discussed. Fades observed on 456 megacycles during one month are compared with those observed on 223 megacycles. The visibility fades appear to be caused by scattering irregularities whose geographical distribution peaks near the maximum of the visual auroral zone. There is evidence of contributions from both the E-layer and F-layer. Primary occurrence maxima appear in autumn and at magnetic midnight. Author

N65-35582*# National Aeronautics and Space Administration, Washington, D. C.
ON THE SUBJECT OF COSMIC FLIGHTS WITHOUT SPACE EQUIPMENT AND WITHOUT PROPELLANT
C. Stankiewicz Oct. 1964 9 p Transl. into ENGLISH of the manuscript "Au Sujet des Vols Cosmiques sans Appareils et sans Alimentation Energetique" Warsaw, 25 May 1964
(NASA-TT-F-9154) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Visions by a Catholic nun in the 19th Century on trips to the moon and planets are described. Phenomena of these visions, such as the appearance of the moon as a ball of fire, metal deposits on the moon, constitution of lunar soil, vegetation on moon and planets are reported. Author

N65-35622# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS OF RENDEZVOUS OF A SPACE VEHICLE WITH AN ORBITAL STATION
G. Yu. Dankov and F. A. Mikhaylov 24 May 1965 14 p refs Transl. into ENGLISH from Russian
(FTD-MT-65-121; AD-615855)

Various schemes for rendezvous in orbit are divided into three categories: direct launching of spacecraft into plane of station orbit, use of phasing ellipse or orbit expectation, and non-coplanar transfer flight. In any of these schemes, there are three stages: powered flight phase, power-off flight phase, and phase of entry into station orbit and maneuvers required to accomplish rendezvous. It is the third stage, referred to as near guidance, that is considered. Equations of relative motion of the space vehicle are developed, and use of second derivative of distance as information about rotation of line of sight is considered. By carrying out measurements of the second derivative of relative distance, with help of the Doppler effect and by use of the obtained information relating to proper control, it is possible to construct a closed-cycle control system for the stage of distant approach. M.W.R.

N65-35675# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DISCONTINUOUS VARIATIONAL PROBLEMS
H. Gardner Moyer Dec. 1964 25 p refs Presented at the IBM Sci. Computing Symp. on Control Theory and Appl., Yorktown Heights, N. Y., Oct. 1964
(Contract AF 49(638)-1207)
(RM-252J; AD-617270)

This paper analyzes variational problems that specify jump discontinuities in the state variables. The solution extremals are required to jump when they reach a manifold of dimension n-q (n is the number of state variables). Two approaches to these problems are presented. The first approach is geometrical and therefore loses most of its practicality as the number of state variables is increased beyond two. The second approach is analytic and therefore much more flexible and powerful. The Lagrange multipliers are obtained from a set of nonlinear equations. They are underdetermined when q is greater than one. After the discontinuity the extremals fill an n-dimensional volume regardless of the value of q. Author

N65-35686# Raytheon Co., Alexandria, Va. Space and Information Systems Div.
PROGRAM AND TEST PROCEDURES TO DETERMINE THE GEOCENTRIC COORDINATES AND ORBITAL PARAMETERS OF AN UNIDENTIFIED SATELLITE Final Report
5 May 1965 23 p
(Contract DA-44-009-AMC-781(X))
(FR-65-141; AD-617698)

A method for solving geocentric position and orbital parameters of an unidentified satellite from a single camera station is presented. It is proposed that the ground station position can be solved if the orbit is known, or that the orbit can be solved if the ground station is known. A fictitious mathematical model was used to test the feasibility of the proposal, on the assumption that if the solution does not work with fictitious data, it will not work with real data. Programs were

written for eleven, nine, eight, six, five, and four unknowns. The results show that no solutions can be obtained for eight unknowns or higher, that solutions can be obtained for six, and five unknowns, and that as the number of unknowns is decreased the solution has smaller variances. A good solution for the ground point with the orbital parameters known can be obtained. L.S.

N65-35688# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
AN INTRODUCTION TO THE GEOLOGY OF THE MOON Special Report No. 23
Luciano B. Ronca May 1965 38 p refs
(AFCRL-65-357; AD-617721)

An introduction to the study of the moon is presented from a geological point of view. The most important theories on lunar features are presented and discussed, and new interpretations are proposed. Lunar physiography, stratigraphy, and tectonics are described. The most important physiographic features are craters, terrae, maria, rilles, wrinkle ridges, rays, halos, mountain ranges, and alpine valleys. From the physiography it is possible to speculate on the geologic processes acting on the moon. These are space weathering, meteoritic impact, volcanism, ballistic transportation and sedimentation, electrostatic transportation, and tectonism. The stratigraphy has been determined by applying the law of superposition. The column consists of the Pre-Imbrian, Imbrian, Procellarian, Eratosthenian, and Copernican Systems. The future of lunar exploration is discussed. Author

N65-35740# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
COLOR EXCESSES IN SIX LUNAR CRATERS ACCORDING TO ELECTROPHOTOMETRIC OBSERVATIONS
K. I. Kozlova and Yu. V. Glagolevskii 23 Oct. 1964 5 p refs Transl. into ENGLISH Astron. Tsirkuliar Akad. Nauk SSSR (Kazan), no. 198, 1958 p 1–2
(RSIC-313; AD-608538)

A telescope and an electrophotometer were used for lunar observations conducted during a full moon in order to minimize the effect of polarization. Photometry was performed on the bottoms of six craters through yellow and blue light filters, and Crater Manillius was chosen as the basis for comparison. The diameter of the aperture which defined the photometric regions was equal to approximately 3/4 the diameter of Manillius. All craters and the base regions were measured 10 times through each filter, and photometry of the base region was conducted immediately following that of each crater. An average of each crater was taken based on the entire series of observations, with the color excess determined in relation to the base Manillius. Color excesses are given in arithmetical averages from a series of measured results. M.G.J.

N65-35743# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE STABILITY OF MOTION OF ARTIFICIAL MOON SATELLITES
G. A. Chebotarev and S. N. Kirpichnikov 7 Apr. 1965 10 p ref Transl. into ENGLISH from Byul. Inst. Teor. Astron. (USSR), v. 8, no. 6, 1962 p 402–404
(FTD-TT-65-106/1+3+4; AD-614764)

The motion of four lunar satellites was investigated by numerical integration to determine the boundaries of motion stability. The interaction of the gravitational field of the moon with the gravitational field of the earth are determining factors in the stability of artificial lunar satellites. This problem is explored and parameters are given for conditions of stability and instability. E.E.B.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see 30 Space Sciences. For related information see also 28 Propulsion Systems; and 32 Structural Mechanics.

N65-34816 Air Force Missile Development Center, Holloman AFB, N. Mex.
APPLICATION OF A TETHERING SYSTEM TO A SPECIFIC REQUIREMENT
Michael S. Kretow *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 135–137 (See N65-34804 23-20)

A balloon tethering method is described for providing a stable and accurately positioned platform for pre-flight and soft landing tests of the NASA Lunar Surveyor vehicle. In order to achieve the stable platform and to allow the Surveyor vehicle to be dropped free of any possible entanglement with tethering lines and to impact within 50 ft of ground zero, three winch equipped trucks are employed for positioning and control. The tether lines form a triangle and are secured to the bottom end fitting of the balloon. The Surveyor vehicle is suspended beneath an open parachute that is also tied to the same bottom end fitting. R.N.A.

N65-35049# Weapons Research Establishment (Australia) Dept. of Supply.
OPERATIONAL TESTING OF A HIGH ALTITUDE PARACHUTE SYSTEM
G. J. Simpson and G. H. Secombe Jul. 1965 19 p refs
(WRE-TN-PAD-106) CFSTI: HC $1.00/MF $0.50

In the development of a high altitude parachute system for use with a dropsonde, a 6 ft diameter parachute found suitable from wind tunnel and free fall tests at sea level has been proved at operational altitude in the trial (AH 281/2) of 26/1/65. The nature and results of the trial are described and recommendations made regarding future tests. Author

N65-35061*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.
TEST-STAND STUDY OF A VEHICLE UPPER STAGE EMPLOYING A ROTATING-SOLID-ROCKET ATTITUDE CONTROL SYSTEM AND A COMPARISON WITH ANALOG STUDIES
A. Thomas Young and Robert L. James, Jr. Washington NASA, Oct. 1964 39 p refs
(NASA-TN-D-2997) CFSTI: HC $2.00/MF $0.50 CSCL 22

A dynamic-test-stand investigation in three degrees of rotational freedom of a space-vehicle upper stage employing a rotating-solid-rocket attitude control system is described. Experimental data received from an onboard telemetry system and a unique photographic technique are presented and compared with results obtained from an analog simulation of the dynamical system. Analysis and comparison of the results from the various sources showed that the system performed as predicted by the analog simulation, thus validating the mathematical representation of the dynamical system. It is shown that the telemetry results, although limited in accuracy, are very valuable in analyzing the attitude control characteristics of the space-vehicle upper stage. Author

N65-35083# Centre National d'Etudes des Telecommunications Issy les Moulineaux (France). Dept. Telecommande
STUDY OF VLF RADIATION BY USE OF A NIKE-CAJUN ROCKET
Claude Renard and Christian Fayard 15 Apr. 1965 63 p refs
(Contract AF 61(052)-571)
(CNET-345-TC; AFCRL-65-564; AD-619250)

The payload of a NIKE CAJUN rocket launched at Wallops (Virginia) consisted of an equipment developed by C.N.E.T. the purpose of which is to measure the magnetic field in the ionosphere of a VLF wave radiated by the Annapolis transmitter (NSS) on 22.3 kc/s. After the measurement principles have been exposed, a detailed description of the equipment is given and the telemetry results are analysed. In spite of an antenna effect on the loops, an approximate measure of the VLF field in the whistler mode between the D and E layers is given. An analysis of the propagation above Wallops-Island is carried out, which allows the development of the processing of the Doppler effect observed on the VLF wave received in the ionosphere. The electron density profile obtained between 70 and 100 km is analysed and shows two layers at 78 and 87 km. Author

N65-35103*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PEGASUS THERMAL DESIGN
Tommy C. Bannister 6 Aug. 1965 76 p refs
(NASA-TM-X-53300) CFSTI: HC $3.00/MF $0.75 CSCL 22B

Many of the components of the Pegasus spacecraft will function properly only so long as their temperatures are maintained within certain tolerances. The thermal requirements, thermal design, and orbital temperature results are presented in this report. When the temperature specifications were received, two areas were recognized to be critical: (1) the micrometeoroid detector panels and (2) the electronics. This report deals primarily with these areas. Quick-look results of the flight data from Pegasus A and B indicate that the thermal design was very successful. None of the component temperatures has extended beyond the design ranges. The critical batteries have been 300° K ±6° K, which is well within their design range (270° K to 322° K), for over 150 orbits on Pegasus A. Author

N65-35133*# National Aeronautics and Space Administration, Washington, D. C.
NASA TO LAUNCH SECOND ORBITING GEOPHYSICAL OBSERVATORY
12 Oct. 1965 57 p
(NASA News Release-65-314) Available from the Scientific and Technical Information Division CSCL 22B

The expected launching of NASA's second Orbiting Geophysical Observatory satellite (OGO-C) is discussed. The OGO-C will be the first satellite launched by a thrust augmented Thor-Agena D rocket. It will carry 20 different experiments to be conducted on near-Earth space phenomena. Emphasis will be on global mapping of the geomagnetic field, and on measurements of the neutral, ionic, and electron composition of the Earth's atmosphere. Data will be correlated with solar ultraviolet and X-ray emissions, and such events as particle dumping in the auroral zones and airglow. Its attitude and thermal control systems, communications and data handling, data processing, and modifications are described. Details of the various scientific objectives and experiments are discussed. Also included are descriptions of the launch vehicle and flight sequence, and tabulations of launch vehicle statistics and satellite physical data. R.N.A.

N65-35211*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY OF LAUNCH-VEHICLE RESPONSES TO DETAILED CHARACTERISTICS OF THE WIND PROFILE
Harold C. Lester and Harold B. Tolefson [1964] 25 p refs Presented at the AMS 5th Conf. on Appl. Meteorology; Atmospheric Probl. of Aerospace Vehicles, Atlantic City, 2–6 May 1964
(NASA-TM-X-54628) CFSTI: HC $1.00/MF $0.50 CSCL 22D

This paper examines the significance of the detailed variations in the vertical wind profile to launch-vehicle responses. Appreciable advances in the accuracy and the degree of detail obtainable in measurements of the winds experienced by vertically rising vehicles have been achieved by smoke-trail rocket sounding techniques and the wind measurements now available from these soundings are being applied to simulated in-flight loads studies. The analysis procedure and computer program employed in solving for the motions and bending moments experienced by a representative launch vehicle are discussed. The interaction of the vehicle's structure with the details of the wind profile is illustrated by a comparison of the structural bending moments with the features of the smoke-rocket measured profiles. Author

N65-35236*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LUNAR ORBITER: ITS MISSION AND CAPABILITY
Israel Taback New York, Am. Astronautical Soc. [1964] 33 p Presented at the 10th Ann. Meeting on Tech. Progr. on Lunar Flight Programs, 4–7 May 1964 Preprint 64-7
(NASA-TM-X-51596) CFSTI: HC $2.00/MF $0.50 CSCL 22B

A description is given of the objectives of the Lunar Orbiter and the measurements which are planned. The project organization and some historical background are presented. The design restraints are outlined and the specifications and requirements for the measurement systems are presented. The proposed spacecraft configuration is described as are selected subsystems and typical trajectories. Maximum use of qualified components and techniques is emphasized and illustrated. It is concluded that because of this, a high probability of success is assured and that the Lunar Orbiter will provide data useful to Apollo and for general scientific purposes. Author

N65-35249*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A SPACECRAFT FOR ION THRUSTOR FLIGHT TESTS
Harold Gold Washington, NASA, 1964 22 p ref Presented at the Natl. Aeron. Meeting and Production Forum sponsored by SAE and ASME, New York, 27–30 Apr. 1964
(NASA-TM-X-52008) CFSTI: HC $1.00/MF $0.50 CSCL 22B

A spacecraft that will be used for flight tests of ion thrustors is described. The spacecraft has been designed to provide measurements of thrustor electrical parameters and thrust. The tests to be carried out will determine the validity of ion thrustor performance data that has been obtained in vacuum chambers. The spacecraft, which will carry two thrustors of different construction, will be launched into a ballistic trajectory by the Scout vehicle. The test time will be approximately 1 hour. Author

N65-35264*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE DEVELOPMENT OF PARAWINGS FOR USE AS RECOVERY SYSTEMS
Charles E. Libbey [1964] 10 p refs Presented at the AIAA Aerospace Sci. Meeting, Washington, D. C., 29 Jun.–2 Jul. 1964
(NASA-TM-X-51628) CFSTI: HC $1.00/MF $0.50 CSCL 22B

Studies were conducted on some of the problems involved in deploying parawings for the recovery of boosters and nonlifting spacecraft. The investigations were conducted by means of radio controlled drop tests of free flying dynamic models. All deployment tests were conducted at low subsonic speeds. The prime considerations were the mechanics and sequencing of events for deployment, and the dynamic stability and control characteristics of the configurations during employment. A limited amount of information was obtained on the model accelerations and suspension line loads for one of the configurations during deployment. Three different types of parawings and four different deployment techniques were studied. Some of the problem areas encountered and the particular solutions employed to alleviate the problems are discussed. The investigations showed that parawings can be successfully deployed at subsonic conditions from boosters and various spacecraft configurations. R.N.A.

N65-35275*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
VOYAGER DESIGN STUDIES. VOLUME IV: ORBITER-BUS DESIGN, PART 1
15 Oct. 1963 373 p
(Contract NASw-697)
(NASA-CR-51833; RAD-TR-63-34, Vol. IV, Pt. 1) CFSTI: HC $7.00/MF $1.75 CSCL 22B

Engineering and design details of the orbiter-bus are presented as part of the Voyager design study to develop an unmanned spacecraft for scientific orbiter-lander missions to Mars and Venus. The orbiter-bus is designed to gather scientific data on surface and atmospheric characteristics while orbiting these planets, and to serve as a bus to guide the lander and a platform to release the lander towards the planet. It is also designed to perform scientific measurements in the interplanetary environment. A summary of characteristics, performance, and weight breakdowns for both the Mars and Venus orbiter-bus designs is presented. The systems which will satisfy the mission and design goals under design constraints are described. Reference systems are presented and/or other systems that were discarded or that could be considered if their continued development bears out their anticipated performance claims. Descriptions are presented on the scientific payload, communications, guidance, stabilization and control, propulsion system, materials, thermal control, and structures for both Mars and Venus orbiter-bus designs. R.N.A.

N65-35276*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
VOYAGER DESIGN STUDIES. VOLUME II: SCIENTIFIC MISSION ANALYSIS
4 Dec. 1963 248 p refs
(Contract NASw-697)
(NASA-CR-51829; RAD-TR-63-34, Vol. II) CFSTI: HC $6.00/MF $1.50 CSCL 22B

A scientific mission analysis is presented as part of the Voyager design study to develop an unmanned spacecraft for scientific orbiter-lander missions to Mars and Venus. A multidisciplinary study of both planets was made to determine areas of primary interest, to note special questions arising from the individual nature of each planet, to interpret the available observations and measurements, and to suggest the most profitable measurements to be made on the Voyager project. Models were proposed and analyzed to predict planetary conditions. Tabulated lists of expected conditions and desired measurements for each discipline are included. An optimization analysis was made of the scientific measurements desired for each planet and for the orbiter and lander. With the measurements selected, the optimum instrumentation was determined. Considerations in selecting the instruments included weight, power, volume, and bits required; deployment and sample acquisition complexity as it affected spacecraft design; and utility for several different desired measurements. A detailed exploration schedule was established for each planet. Specific landing sites were selected for each planet with reasons as to their importance. R.N.A.

N65-35277*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER DESIGN STUDY. VOLUME III: SUBSYSTEM DESIGN, PART I
15 Oct. 1963 361 p refs *Its* Doc.-63SD801, Vol. 3, Pt. 1
(Contract NASw-696)
(NASA-CR-58185) CFSTI: HC $7.00/MF $2.00 CSCL 22B

The recommended communications and television subsystems, and radar equipment for the Mars 1969, 1971, 1973, and 1975, and the Venus 1970 and 1972 Voyager missions are described. The parameters and requirements characterizing each vehicle with respect to communication for each mission are tabulated, and data are given on such subsystems as command and computer; data processing and storage; deep-space transmission; relay transmission; communications techniques; component selection; and typical operating sequences—Mars 1969. The television mission for the various vehicles and mission opportunities are tabulated, and the systems constraints imposed on the subsystem in the form of orbital geometry and transmission bandwidths are listed, along with the television camera requirements. An analysis is included on the three major components: optics, sensors, and camera electronics. Criteria for selecting radar sensors are given, and approaches to fine resolution radar mapping are discussed. It was pointed out that the basic radar subsystems to be developed are the terrain mapping radar, radar surface sounder, and ionospheric sounder. M.G.J.

N65-35278*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
VOYAGER DESIGN STUDIES. VOLUME IV: ORBITER-BUS DESIGN, PART II
15 Oct. 1963 377 p
(Contract NASw-697)
(NASA-CR-58226; RAD-TR-63-34, Vol. IV, Pt. II) CFSTI: HC $7.00/MF $2.00 CSCL 22B

Engineering and design details of the orbiter-bus for the Voyager unmanned spacecraft are presented. Described are the propulsion system, materials, thermal control, and structures. Included with the report are configuration diagrams, charts, tables, calculations, performance parameters, trajectory information, system characteristics, power requirements, success probabilities, weight summaries, and other detailed technical material relating to the orbiter-bus systems. L.S.

N65-35279*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
VOYAGER DESIGN STUDY. VOLUME II: MISSION AND SYSTEM ANALYSIS
15 Oct. 1963 356 p refs *Its* Doc.-63SD901, Vol. II
(Contract NASw-696)
(NASA-CR-51835) CFSTI: HC $7.00/MF $2.00 CSCL 22

The Voyager mission is analyzed and spacecraft systems to accomplish this mission are evaluated. The primary scientific objectives are the detection and characterization of extraterrestrial life, the exploration of planetary surfaces and

interiors, and the investigation of planetary atmospheres, with the secondary objective of acquiring the information necessary for the development of manned exploration systems. The choice of a scientific instrumentation payload to accomplish these objectives is discussed. The energy requirements for various Mars and Venus opportunities are analyzed on a parametric basis to determine the variation of total mission capability with the type of orbits and the sizes of the orbiter and lander modules. The final system incorporates one or two landers and an orbiter with a single propulsion system for midcourse, terminal, and orbit injection maneuvers. The main communication link from the lander to .he earth is through a relay in the orbiter. An evolutionary Voyager program is presented based on the weight capabilities of the Saturn C-1B launch vehicle with the S-VI upper stage, however, substitution of the Titan III-C would have flexibility and cost advantages. M.P.G.

N65-35280*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
VOYAGER DESIGN STUDIES. VOLUME V: LANDER DESIGN, PART II
15 Oct. 1963 397 p
(Contract NASw-697)
(NASA-CR-58227; RAD-TR-63-34, Vol. V, Pt. II) CFSTI: HC $7.00/MF $2.00 CSCL 22B

Engineering and design data for the Voyager lander system are reported. Presented is a brief description of the salient performance features of the various power systems examined for the Mars lander, a discussion of the selected 110-watt radioisotope (Pu-238) thermoelectric (Ge-Si) generator, nickel cadmium battery system; and a description of the Mars lander communication system. Also described are the power and communication system requirements for the Venus lander. Included are mechanical-, structural-, aerodynamic-, heat shield-, and descent system-design data for the Venus lander. S.C.W.

N65-35286*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
VOYAGER DESIGN STUDIES. VOLUME V: LANDER DESIGN, PART I
15 Oct. 1963 251 p
(Contract NASw-697)
(NASA-CR-51832; RAD-TR-63-34, Vol. V, Pt. I) CFSTI: HC $6.00/MF $1.50 CSCL 22B

An engineering and conceptual design study of a lander system for the Voyager unmanned spacecraft is presented. Described are the mechanical and aerodynamic designs, descent and landing systems, heat shield and structure design, power supply, and communication systems for both the Mars and Venus approach. Numerous tables and detailed diagrams are included in the report. The development plan shows that to obtain the scientific value desired, two spacecraft should be scheduled for each launch opportunity. L.S.

N65-35311*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN IB/V ASTRIONICS SYSTEM
S. M. Seltzer 14 Nov. 1963 19 p
(NASA-TM-X-51818; MTP-ASTR-S-63-15) CFSTI: HC $1.00/MF $0.50 CSCL 22B

A brief semitechnical functional description of the astrionics systems for the Saturn IB and V launch vehicles is presented. The astrionics equipment consists of the vehicle guidance, control, and instrumentation systems. The adaptive guidance mode and the manner in which the mission is to take place are also briefly described. The Saturn IB and V vehicles will use almost identical astrionics systems; minor differences may be caused by the reflection upon the astrionics systems of two or three stages or by the assigned mission. Author

N65-35312*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
VOYAGER DESIGN STUDIES. VOLUME III: SYSTEMS ANALYSIS Final Report
15 Oct. 1963 317 p refs
(Contract NASw-697)
(NASA-CR-51830; AVCO-RAD-TR-63-34) CFSTI: HC $7.00/MF $1.75 CSCL 22B

Continued research focusing on the synthesis of a conceptual design of an unmanned spacecraft to perform scientific orbiter-lander missions to Mars and Venus during planetary opportunities from 1969 to 1975, and the formulation of a plan delineating the development program leading to first launch during the Mars 1969 opportunity, is reported. Presented are systems analysis data which include results of interdisciplinary analyses and tradeoff studies which influence Voyager spacecraft design. Also presented is a mission profile which outlines the sequential operations throughout the spacecraft mission and develops the anticipated environment for each segment of the operational spacecraft life. Results of these studies were used in the development of the orbiter and lander vehicles, and the scientific mission. S.C.W.

N65-35313*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
VOYAGER DESIGN STUDIES. VOLUME I: SUMMARY
15 Oct. 1963 122 p refs
(Contract NASw-697)
(NASA-CR-57828; AVCO-RAD-TR-63-34) CFSTI: HC $4.00/MF $0.75 CSCL 22B

A synopsis of a conceptual design study of the Mars Voyager spacecraft is reported. The objectives of the study were the synthesis of a conceptual design of an unmanned spacecraft to perform scientific orbiter-lander missions to Mars and Venus during planetary opportunities from 1969 to 1975, and the formulation of a plan delineating the development program leading to first launch during the Mars 1969 opportunity. Presented are data on the mission evolution for Voyager exploration of Mars and Venus; major system tradeoffs, trajectory and payload optimization, reliability, and sterilization; design features of each vehicle and its subsystems which include the Mars orbiter-bus, the Mars lander, the modified lander designed for the revised Mars atmosphere, the Venus orbiter-bus, the Venus capsule, and the Venus lander; and the development plan for accomplishing the program. S.C.W.

N65-35564# Naval Ordnance Test Station, China Lake, Calif.
HITAB-BWSS PAYLOADS
John A. Hoyem, James E. Hurtt, and Larry N. Pace Aug. 1965 43 p refs
(ARPA Order 243-61; Proj. Defender)
(NAVWEPS-8738; NOTS-TP-3799; AD-619058)

The objective of the HITAB program was that of measuring certain infrared and ultraviolet characteristics of in-flight ballistic missile plumes, and of selected earth backgrounds. The measurements were obtained from instrumented high-altitude rocket probes. This report documents the HITAB-BWSS payloads, which were designed to measure the Wiener spectrum of the earth's background in several narrow regions of the infrared. Experiment description, mission profile, vehicle-payload configuration, optics, optical calibration and a resumé of the rocket flights are presented. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-34774# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELLIPTICAL HOLE WITH CRACKS
A. O. Kaminskiy 11 Aug. 1965 9 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. RSR (Kiev), no. 10, 1964 p 1301–1305
(FTD-TT-65-600/1+2+4; AD-619332)

The author considers the problem of the brittle breakdown of a plate weakened by an arbitrary elliptical hole with two balanced cracks in the case of "all-round" tension of a plate. Author

N65-34817 Vitro Labs., Silver Spring, Md.
DESIGN CONSIDERATIONS FOR SOFT LANDING OF BALLOON PAYLOADS
J. P. Jackson *In* AFCRL Proc., 1964 AFCRL Sci. Balloon Symp. Jul. 1965 p 139–155 refs (See N65-34804 23-20)

Five energy absorption methods for soft landing balloon payloads are discussed. The methods include material deformation, gas compression, mass acceleration, friction, and chemical energy. Material deformation systems use paper or metal honeycomb material, foamed plastic, or balsa wood. One difficulty of honeycomb material is its directional properties. However, all these systems are simple, reliable, inexpensive, and require no complex actuating devices. Gas bags offer flexibility in obtaining specific desired values of deceleration and deceleration-onset rate, but once designed to satisfy a specified set of conditions, they can tolerate little deviation from those conditions without serious effects. They are also expensive and suffer from directional properties. Mass acceleration methods involve aerial snatch and the impact spike. They require auxiliary equipment in a proper location. A frangible tube method of absorbing energy by friction offers an increase in energy absorbing capacity. Retro rockets maintain deceleration and deceleration-onset rate at low values, but require careful timing and thrust control, and are expensive.
R.N.A.

N65-35042# Naval Ordnance Lab., White Oak, Md.
DYNAMIC COMPRESSION TESTING OF CRUSHER GAGE MATERIAL Ballistics Research Report No. 125
James L. Rand Sep. 1965 16 p refs
(NOLTR-63-277; AD-619522)

In order to determine the validity of static calibration of crusher gages, annealed copper crusher gage material has been tested in compression at room temperature at rates of strain from 1.66×10^{-3} in./in./sec to 7.15×10^{3} in./in./sec. A modified Hopkinson bar apparatus as originally used by Kolsky was used to obtain dynamic stress-strain relations for this material. It has been found that this material is weakly strain rate sensitive and static calibration of crusher gages will introduce an insignificant error in the measurement of dynamic peak pressures. Author

N65-35058*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF LIQUID IMPACT IN A MODEL PROPELLANT TANK
David G. Stephens Washington, NASA, Oct. 1965 22 p refs (NASA-TN-D-2913) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An experimental investigation was conducted to assess the problem of liquid impact in booster and space vehicle propellant tanks. A partially filled cylindrical tank with hemispherical ends was subjected to sudden reversals in axial acceleration. The liquid behavior was observed, the structural loads were measured, and methods of impact attenuation were evaluated. Variables included tank acceleration, initial condition of the liquid free surface, baffle configuration, and a range of liquid viscosity, vapor pressure, and surface tension. The liquid response was found to be highly dependent upon the behavior of the free surface just prior to the change in acceleration. A "geysering" action was observed when the surface was initially quiescent whereas a continuous flow around the walls and bulkhead was observed in cases where a slosh mode was present. The magnitude of the impact was attenuated appreciably by screen baffles but was insensitive to changes in liquid viscosity, vapor pressure, and surface tension. The impact loads observed in these tests, however, do not appear to be of sufficient magnitude to pose a significant structural problem. Author

N65-35066*# National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.
AN INVESTIGATION OF A DEFORMING ENERGY-ABSORPTION SYSTEM FOR SPACE-VEHICLE LANDINGS
Robert W. Warner, Robert M. Sorenson, and Arthur J. Kaskey Washington, NASA, Oct. 1965 37 p refs
(NASA-TN-D-3061) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A deforming system for protecting a space vehicle during a landing impact is described and experimentally evaluated. The impact energy is absorbed mostly by the cutting of plastic foam pads, but partially by the buckling of their tubular support structure. Expandable foam is chosen because of its advantages in packaging and in reducing penetration of the landing surface. The foam and its supporting structure are utilized in such a way as to benefit tip-over stability and overall efficiency of energy absorption (energy absorbed divided by the weight of the entire energy absorbing system), with priority given to the latter. The resulting system, when compared with another proposed system, has exceptionally good overall efficiency, namely 545 ft-lb/lb, but has less satisfactory stability, with the model vehicle restricted to a 5° ground slope and nearly vertical impacts. Author

N65-35093# Little (Arthur D.) Inc., Cambridge, Mass.
DESIGN CRITERIA, TECHNICAL CHARACTERISTICS, AND DESIGN CONCEPTS FOR AN AIR TRANSPORTABLE CONTAINER
Charles W. Wood, John H. Watts, and Robert M. Lucas Ft. Eustis, Va., Army Aviation Mater. Labs., Jun. 1965 170 p refs
(Contract DA-44-177-AMC-210(T))
(C-66529; USAAML-TR-65-36; AD-619158)

This report presents the results of a study to determine the feasibility of containerization for Army resupply items. The study has been limited to air transportation of supply classes I through IV shipped from a point of origin in the United States to an overseas forward area. Container criteria for size, weight, cost, strength, effectiveness and general characteristics were developed. Then the design criteria were used as the basis for evaluating the suitability of various materials and conceptual container designs. An acceptable container design appears to be feasible. Author

N65-35118*# Alabama Univ., University. Bureau of Engineering Research.
THE THERMAL EFFECT ON CONICAL SHELLS OF LINEARLY VARYING THICKNESS Progress Report No. 2
Chin Hao Chang May 1965 18 p refs
(Contract NAS8-11155)
(NASA-CR-67260) CFSTI: HC $1.00/MF $0.50 CSCL 20K

A study of an isotropic conical shell of linearly varying thickness under a surface temperature is made. The thermal effect on the shell is represented by an equivalent load. Asymptotic particular solutions due to the thermal load are obtained. One may combine these solutions with the complimentary solutions of the shell obtained in a previous report to constitute a set of complete solutions. A numerical example of a semi-circular cone frustum subjected to temperature functions that are constant along the meridians and have a sinusoidal distribution in the circumferential direction is given. Author

N65-35184# Atomics International, Canoga Park, Calif.
EFFECT OF CARBURIZATION ON THE LOW STRAIN RATE BEHAVIOR OF TYPE 304 STAINLESS STEEL
D. H. Stone and A. D. Schwartz 31 Aug. 1965 39 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10487) CFSTI: $2.00

Pressure stress-rupture specimens of thin walled Type 304 stainless steel tubing have been tested at temperatures to 1300° F in the presence of an internal diffusion limited carbon source. The tests have determined the effect of simultaneous carburization on the low strain rate behavior of Type 304 stainless steel. The stress–rupture life of a tube tested in sodium with a carbon source is over twice as great as the tube life in the absence of the carbon source. All failures have occurred in the longitudinal seam weld of the tubing due to the more favorable creep characteristics of the fine grained weld over the coarser grain parent metal. Failures are intergranular and are less than 0.0005-in. diameter. Indications are that total carbon increase of 0.20 wt.% during test were not detrimental to the strain behavior of the cladding. Author

N65-35205*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE PREDICTION OF NOTCH AND CRACK STRENGTH UNDER STATIC OR FATIGUE LOADING
Paul Kuhn [1964] 46 p refs Presented at the 1964 SAE-ASME Natl. Air Transport and Space Meeting and Production Forum, New York 27–30 Apr. 1964
(NASA-TM-X-54535) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A method of notch analysis for dealing with notch problems in a unified manner is discussed. It demonstrates the capability of predicting fatigue notch factors, as well as static strength notch factors, by using conventional tensile properties and a Neuber constant as a basis. For low alloy steels, wrought aluminum alloys, and titanium alloys, Neuber constants are defined by curves and may be regarded as known. For aluminum alloys, it is shown that the Neuber constants may be used to compute either fatigue or static notch factors. This method of notch analysis is intended chiefly for use in fatigue design and in the strength analysis of structures containing cracks. It permits greatly increased utilization of the existing information on notch and crack strength of materials because it gives reliable comparisons between tests made on specimens of widely different widths and with different types of notches. It also aids in making a more rational choice for notch testing. The scope of this method has been greatly extended for formulas which make it applicable to cylinders and to stiffened sheet. R.R.D.

N65-35213*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRAIN AGING EFFECTS IN TUNGSTEN DUE TO CARBON
Joseph R. Stephens and G. Willy Form Washington, NASA, 1964 36 p refs Presented at the Symp. on Phys. Met. of Refractory Metals, Am. Inst. of Mining, Met. and Petrol. Engr., New York, 16–20 Feb. 1964
(NASA-TM-X-52000) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Strain aging characteristics of tungsten containing 8 and 40 ppm carbon were determined. Completely recrystallized tensile specimens were prestrained various amounts at 700° F and aged at 1200°, 1500°, and 1800° F for times up to 4 hours. Results show that dislocation locking by solute atoms was weak for the lower carbon level as evidenced by the lack of a yield drop in either the prestrained or aged condition. Specimens containing 40 ppm carbon exhibited a yield drop during the prestrain test. Aging for 120 minutes at 1200° F did not result in a return of the yield drop. The strain aging parameter, which reflects a summary effect involving recovery, strain aging, and precipitation hardening, was negative for short aging times but increased to a positive value after aging for longer times. Aging at 1500° and 1800° F resulted in a return of the yield drop, and the strain aging parameter was positive for all aging times. Explanation of these phenomena are proposed in terms of recent theories. Author

N65-35238*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EVALUATION OF THE IMPACT PERFORMANCE OF REALISTIC SPACE STRUCTURES
James L. Summers [1964] 34 p refs Presented at Conf. on "The Fluid Dyn. Aspect of Space Flight", AGARD Specialists Meeting, Marseilles, 20–24 Apr. 1964
(NASA-TM-X-51620) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Small spheres of aluminum and glass were fired at velocities from 4,000 to 23,000 feet per second into a variety of composite structures representative of various types of space vehicle construction. These structures were single-walled samples, multiple-walled samples having a variety of fillers of different composition and density including structural elements of aluminum honeycomb, and nonmetallic materials representative of ablative heat-shield components. The results of the tests indicated that, first, the impact performance criterion selected strongly influences the choice of the final structural configuration and, second, because of the complex nature of the failure of composite structures, realistic test specimens must be employed. Author

N65-35261*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MISMATCH STRESSES IN PRESSURE VESSELS
Robert H. Johns 6 Apr. 1964 3 p Submitted for Publication
(NASA-TM-X-51644) CFSTI: HC $1.00/MF $0.50 CSCL 20K

As pressure vessel segments are often joined together at circumferential joints by welds or other means, an approximate analysis for the stresses arising at such joints was developed. The method is considered applicable to any nonshallow shell of revolution in which the meridional tangents of the two segments are parallel to each other at the junction. Equations are presented which avoid the need of using edge-loaded shell equations for the particular geometry being considered. The results agree with results computed from the linear edge influence coefficients; and solutions are found that are applicable to both axisymmetric and local mismatches. A simple formula is suggested for approximating the effect of mismatch: the effective stress concentration factor is 1 plus the mismatch given as a fraction of the thickness. M.G.J.

N65-35265*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ATTENUATION OF LANDING IMPACT FOR MANNED SPACECRAFT
Jerry E. Mc Cullough, Frank A. Stafford, and Harold E. Benson [1964] 17 p Presented at Symp. on Parachute Technol. and Evaluation, El Centro, Calif., 7–9 Apr. 1964
(NASA-CR-53291) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An outline of the techniques used in the selection, design, development, and qualification of spacecraft impact attenuation systems is presented. The impact attenuation systems used in NASA's current manned space programs (Mercury, Gemini, Apollo command module, and lunar excursion model) are discussed, including the basis for selection, development procedures, and some of the development problems encountered.
R.N.A.

N65-35291# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
GENERAL INSTABILITY OF CONICAL SHELLS WITH NON-UNIFORMLY SPACED STIFFENERS UNDER HYDROSTATIC PRESSURE Scientific Report No. 1
Menahem Baruch, Josef Singer, and Ovadia Harari Dec. 1964 46 p refs
(Grant AF-EOAR-63-58)
(TAE-37; AD-617151)

The method of analysis of the general instability of stiffened conical shells, for uniform and equally spaced stiffeners, is extended to shells with non-uniformly spaced stiffeners. For hydrostatic pressure loading, rings are the most efficient stiffeners. On account of the cone geometry, equally spaced rings divide a conical shell into sub-shells of unequal local buckling strength. Hence unequal spacings, which result in subshells of equal local buckling strength, are the logical approach to an optimum structure. A rule for such spacings is derived and discussed. The analysis is then given for conical shells with rings spaced according to rules of this type. Numerical calculations are presented and discussed. A simplified approximate formula for the critical pressure is also proposed. Author

N65-35293# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
SUPERSONIC FLUTTER OF CIRCULAR CYLINDRICAL SHELLS SUBJECTED TO INTERNAL PRESSURE AND AXIAL COMPRESSION
Mervyn D. Olson Apr. 1965 110 p refs
(Contract AF 49(638)-1364)
(SM-65-7; AFOSR-65-0599; AD-619729)

Experiments were conducted on thin-walled circular cylindrical shells for the study of flutter in the vicinity of buckling. The static pressure distribution over the thin shell section of the flutter model was measured and the flutter of three 0.0004 inch thick shells subjected to radial external pressure loading and to combinations of axial compression and internal pressure were investigated. Small amounts of internal pressure were found to be very stabilizing with respect to flutter, but moderate amounts reduced stability to the unpressurized level. High internal pressures completely stabilized the shell independent of axial load or previous permanent buckling deformations. Axial compression was found to be slightly destabilizing when the internal pressure was positive, but was slightly stabilizing when the internal pressure was near zero or negative. It appears that the large local curvatures encountered in the buckling of a cylindrical shell have a marked stabilizing effect on the shell locally. However, it also appears that the localized buckling usually encountered in practice significantly reduces the stability of any unbuckled regions of the shell. E.E.B.

N65-35297# Michigan Univ., Ann Arbor.
VERTICAL MOTION OF RIGID FOOTINGS
J. Lysmer (Ph.D. Thesis) Jun. 1965 147 p refs
(Contract DA-22-079-ENG-340)
(Rept.-3-115; AD-469600)

A half-space model is described for the representation of vertical motions of an actual footing-soil system. It is shown that the frequency range can be extended to include all frequencies of steady-state motion and also how this complete steady state solution can be used to calculate the transient response caused by an arbitrary pulse loading. The effect of the energy loss is comparable to that of the dashpot in a simple damped oscillator. A simplified spring-dashpot analog has been adopted for performing practical calculations. This analog differs from previously suggested analogs in that its components are independent of the frequency of the exciting force. The analog can therefore be used to predict the response to dynamic pulses of arbitrary shape by means of the classical methods for a damped oscillator. G.A.L.

N65-35353*# California Univ., Berkeley. Space Sciences Lab.
INVESTIGATION OF DYNAMIC STRESSES IN DETONATION Technical Note No. 7
R. D. Wing, M. C. de Malherbe, and A. J. Laderman Aug. 1964 138 p refs *Its* Series No. 5, Iss. No. 46
(Contract NAS8-2634)
(NASA-CR-67308) CFSTI: HC $4.00/MF $1.00 CSCL 20K

This work reports a study made of the stresses induced in a thin cylindrical tube by internal blast loading from a detonation wave. A method for the prediction of the cylinder's stress response has been developed on the basis of a simple dynamic model of the vibrating system and an approximate expression for the shape of the blast loading wave. This investigation was associated with an experimental study of detonation phenomena in hydrogen-oxygen mixtures contained in large diameter cylindrical vessels. The safety of the vessel is critically dependent upon the magnitude of the hoop stresses induced in the cylinder walls by the detonation process. A strain measuring system utilizing semiconductor strain gauges was employed to monitor the stresses, and these results, in conjunction with the theoretical stress predictions, provided a satisfactory check on the state of stress in the metal.
Author

N65-35392*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
INVESTIGATION OF STRUCTURAL PROPERTIES OF FIBERGLASS FILAMENT-WOUND PRESSURE VESSELS AT CRYOGENIC TEMPERATURES
J. M. Toth, Jr., W. C. Sherman, and D. J. Soltysiak Sep. 1965 126 p refs
(Contract NAS3-2562)
(NASA-CR-54393; SM-48845) CFSTI: HC $4.00/MF $1.00 CSCL 20K

This investigation was made to determine such structural properties through the use of a typical 18-in.-diam pressure test vessel. It was realized at the outset that providing a suitable liner would be a major problem. Accordingly, the initial effort dealt with the testing of various candidate liner materials. Data were obtained on mechanical properties, permeability, thermal contraction, and cyclic resistance of polymeric and electrodeposited metallic materials. The number of cycles that can be achieved by a pressure vessel operating in the range of 1 to 2-1/2% strain is dependent upon the ability of the bond between the vessel wall and liner to prevent the liner from buckling and upon the ability of the liner to resist fracture when subjected to high plastic tensile and compressive strains. The

investigated polymeric films had a low total elongation which, coupled with their high differential-contraction rates as compared with the glass-resin composites, made them unsuitable for liners in filament-wound pressure vessels operating at high strains and designed to take all of the strain in tension. A large number of cycles were achieved to take all of the strain in tension. A large number of cycles were achieved with a 7-1/2-in.-diam biaxial cylinder containing a 5-mil electrodeposited-nickel liner cycled at approximately 0.8% strain with liquid hydrogen. Author

N65-35411*# Alabama Univ., University. Bureau of Engineering Research.
ON CONICAL SHELLS OF LINEARLY VARYING THICKNESS SUBJECTED TO LATERAL NORMAL LOADS Progress Report No. 1
Chin Hao Chang Feb. 1965 32 p refs
(Contract NAS8-11155)
(NASA-CR-67330) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The basic equations of conical shells of linearly varying thickness and an approach to the homogeneous solutions were given in "Stresses in Shells" by W. Flügge. The homogeneous solutions were hinged on an eighth degree characteristic equation. In this report, along the line of the theory, the characteristic equation is given in a different form, and a method of solving the equation is also presented. When the ratio of the end thickness to total length approaches zero asymptotically, it is found that the solution consists of two parts: membrance and bending. The two parts are coupled by the lateral displacement. The particular solutions due to lateral normal loads are also given along with a numerical example of a truncated semicircular cone. Author

N65-35426*# National Aeronautics and Space Administration, Washington, D. C
THE EFFECT OF METEOROID FLUX VELOCITY DISTRIBUTION AND ANGLE OF IMPACT UPON THE DESIGN OF SPACECRAFT METEOROID PROTECTION SYSTEMS
Nathaniel B. Cohen 25 Oct. 1963 3 p *Its* Working Paper No. 1001
(NASA-TM-X-51872) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The effect of oblique impact of an isotropic sporadic meteoroid flux, with a population distributed among all velocities within the meteoroid range, is analyzed relative to the equivalent flux for normal impact and a fixed velocity of 30 km/sec. Results of the analysis show a reduction of about 50 percent in the penetrating flux including obliqueness and velocity distribution as compared to the normal impact of 30 km/sec, with the oblique impact effect for an isotropic flux dominating over the velocity distribution effect. This result also shows some dependence on the type of flux and penetration relations used. The isotropic flux and velocity distribution effects are shown to lead to a 16 percent and 21 percent reduction in spacecraft weight for a meteoroid protection system of specified reliability with use of two different flux-visual magnitude relations. It is concluded that these effects should be included among spacecraft design considerations. Author

N65-35512# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
NEW PROCESS FOR THE DETERMINATION OF THE CHARACTERISTIC VALUES IN VIBRATION TESTS [NOUVEAUX PROCEDES POUR LA DETERMINATION DES VALEURS CARACTERISTIQUES DANS L'ESSAI DE VIBRATION]
Gerhard de Vries 1965 14 p refs In FRENCH; ENGLISH summary
(ONERA-TN-82) CFSTI: HC $1.00/MF $0.50

Actual mechanical structures submitted to vibration tests show certain differences in their vibratory behavior when compared to the mathematical model used for processing the experimental data. In some cases these differences due to non-linearities, to an irregular linearity and to a lack of correspondence between the distribution of the dissipative forces in the structure and in the mathematical model, make impossible the exact measurement of the structural parameters. The various methods developed to take account of these differences, and the corresponding equipment, are discussed. Author

N65-35566# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LOSS IN STABILITY OF SHELLS OF ROTATION UNDER INTERNAL PRESSURE
A. V. Pogorelov 5 Aug. 1965 7 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 159, no. 6, 1964 p 1247-1248
(FTD-TT-65-588/1+2+4; AD-619330)

Experiments have shown that a convex shell of rotation may lose stability and begin buckling under internal pressure. This phenomenon is analyzed by considering the geometric characteristics of such a shell. It is assumed that the buckling takes place over the system of small elliptical areas situated along a certain parallel. The energy of shell deformation is considered concentrated on the boundary of buckling areas and per unit of boundary length. Formulas are given for determination of the deformation energy, change in volume due to buckling, displacement, critical pressure, and change in radius of the shell of rotation. E.E.B.

N65-35571# Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.
PREDICTION OF DYNAMIC RESPONSE FROM FLUTTER ANALYSIS SOLUTIONS
Frank J. Frueh and Jacob M. Miller Jun. 1965 68 p refs
(Contract AF 49(638)-1015)
(AFOSR-65-0952; AD-620867)

This report presents the development of a dynamic response prediction method based on the transformation of classicial flutter analysis solutions. This development is accomplished through investigation of the equations of motion of the flutter system for the determination of relationships of this system which are also common to the dynamically responding system's equations of motion. Several special operators were discovered to relate these two systems. Theodorsen incompressible aerodynamics and Ackeret's source pulse aerodynamics were used in the development of the dynamic response prediction method. As a result of these efforts, the analyst may now predict an aeroelastic system's dynamic response in a manner independent of system basic parameters by merely transforming the solutions of a simple-harmonic-motion, required-structural-damping flutter analysis. Author

N65-35604# Litton Systems, Inc., St. Paul., Minn. Applied Science Div.
DETERMINATION OF THE SHAPE OF A FREE BALLOON Final Report, 1 Mar. 1964-15 Feb. 1965
Justin H. Smalley 5 Feb. 1965 78 p refs *Its* Rept.-2713
(Contract AF 19(628)-2783)
(AFCRL-65-92; AD-614810)

Differential equations for the shape, stresses, area, and volume of fully tailored, cylinder, cylinder-end, and tapertangent balloon designs are given. Design data are presented

for fully tailored and cylinder balloons. The accuracy of the data is shown to be well within the requirements for balloon design. Recommendations for further work are included. Author

N65-35624# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPROXIMATION METHOD OF SOLVING ELASTIC-PLASTIC PROBLEMS
P. I. Perlin 4 Dec. 1964 9 p refs Transl. into ENGLISH from Inzh. Sb., Inst. Mekhan., Akad. Nauk SSSR (Moscow), v. 28, 1960 p 145–150
(FTD-TT-64-424/1+2; AD-610795)

A method of solving elastic–plastic problems in the case of flat-deformed and flat-strained conditions is proposed. Statistically definite solutions are examined, in which the strained state in the plastic zone is determined independently of the solution for the elastic–plastic problem; the condition of plasticity is taken in the Saint Venant or Mises form. A problem for a plate weakened by a round opening with stresses through infinity is considered; the ordinary direct solution involves a definite boundary between the elastic and the plastic zones with a given value for the stresses through infinity. A reverse setup is proposed, whereby both the boundary between the zones and the stress through infinity are determined if any two points of the boundary are given. Computations are presented for cases of complete and incomplete envelopment of the opening by the plastic zone. M.G.J.

N65-35625# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF NONUNIFORMLY HEATED PLATES
R. A. Adadurov 15 Dec. 1964 22 p refs Transl. into ENGLISH from Tepl. Napryazh. v Elementakh Turbomashin, Dokl. Soveshch., Inst. Mekhan., Akad. Nauk SSSR., no. 1, 1961 p 121–137
(FTD-TT-64-557/1+2; AD-610417)

A discussion is given of a solution of the problem concerning the stressed state and stability of a thin rectangular plate of variable thickness, nonuniformly heated in width and stressed at the fronts by torsional moments H and bending moments M. Author

N65-35641# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
VARIATIONAL PRINCIPLES IN THE LINEAR DYNAMIC THEORY OF VISCOELASTICITY Technical Report No. 98
Marshall J. Leitman Apr. 1965 26 p refs
(Contract Nonr-562(10))
(C11-98; AD-615322)

Variational principles characterizing the standard initial value problems of linear elastodynamics are extended to dynamic viscoelasticity theory. Notational agreements and mathematical preliminaries are given. The initial history problem is formulated for the dynamic linear theory of viscoelasticity and two equivalent characterizations of its solutions are deduced. Three variational principles applicable to the mixed boundary value problem are proven. R.N.A.

N65-35653# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
VIBRATIONS OF FREELY-SUPPORTED ORTHOTROPIC CYLINDRICAL SHELLS UNDER INTERNAL PRESSURE
Peter R. Di Giovanni and John Dugundji Feb. 1965 79 p refs
(Grant AF-AFOSR-62-363)
(AFOSR-65-0840; ASRL-TR-112-4; AD-617269)

The influence of orthotropicity and internal pressure on the natural frequencies of a thin cylindrical shell whose ends are freely supported is found, using the shell equations of Washizu. Other common shell theories are also presented. Calculations are performed for four constant thickness orthotropic cylinders, two stiffened cylinders, and a basic isotropic cylinder. For these calculations, only the special cases of axial and circumferential stiffening were considered. It is noted that there is a difference in the behavior of the frequencies for the $n = 0$, $n = 1$, and $n \geq 2$ modes. For the $n \geq 2$ modes, the lowest frequency is associated with predominantly radial motion. For the $n = 0$ mode, the lowest frequency is either associated with uncoupled torsional motion or predominantly radial motion, depending on the axial wave length. For the $n = 1$ mode, the lowest frequency is associated with a combination of circumferential and radial motion. Author

N65-35659# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.
STRESS WAVES IN BOUNDED MEDIA Quarterly Report, 1 Mar.–31 May 1965
Richard W. Watson, Karl R. Becker, and Frank C. Gibson 22 Jun. 1965 36 p refs Sponsored by the Army
(AD-617195)

A shock-wave signature technique based on the 130-kilobar phase transition in iron was explored. In addition, a spherical shock source to be used in shock reflection studies was developed and calibrated. The results of a detonation-rate study, using both liquid and solid explosive systems as well as some theoretical computation of the oblique collision of metallic liners are also reported. Graphs, pictures, diagrams, and tables in support of the stress wave study are included. L.S.

N65-35666# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
ACTIVE CONTROL OF BOOSTER ACTIVITY Final Report, Oct. 1963–Aug. 1964
Robert L. Swaim Apr. 1965 82 p refs
(AFFDL-TR-64-189; AD-617314)

An investigation was made of the problem of providing an automatic control system for a large booster subject to severe mode interaction. For the booster considered, the interaction resulted in a rigid-body mode static divergence for an aerodynamically, statically stable, rigid configuration in the uncontrolled or forward-loop-only system. It was shown that preliminary control system design must include the significant elastic modes when mode interaction is present. The investigation revealed that the active control philosophy of using auxiliary control inputs to increase the frequencies of the elastic modes sufficient to reduce the mode of interaction in the forward-loop is a false notion. It is the free-free bending modes which interact with the rigid-body motion, and input forces cannot alter their mode shapes and frequencies. They can be altered only by mass and structural stiffness changes to the basic vehicle. The input forces result in changes to elastic mode coupled frequencies and damping ratios which do not affect the mode interaction. Analysis has shown that it is meaningless to specify desired transient response in terms of closed-loop, short-period frequency and damping ratio as a criterion for control system synthesis when the vehicle is subject to severe mode interaction. In general, the closed-loop modes cannot be identified as being elastic or rigid-body in the conventional sense. Author

N65-35668# RAND Corp., Santa Monica, Calif.
A PROPOSED SCALING LAW FOR HYPERVELOCITY IMPACTS BETWEEN A PROJECTILE AND A TARGET OF DISSIMILAR MATERIAL

R. L. Bjork and A. E. Olshaker May 1965 44 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-2926-PR; AD-617339)

The initial particle velocity produced in a target struck by a hypervelocity projectile is taken to be a significant parameter in determining target penetration. It is found that one can fit a large body of experimental data by assuming that penetrations are linearly proportional to this velocity for projectiles of a given mass and velocity striking a given target. The relation is found to hold over the projectile-density range of 1.75 to 19.3 gm/cm^3. Using other hypervelocity scaling laws, the relation is extended to apply to projectiles of any dimension. Based on this relation, the scaling factors were calculated for nine metals and volcanic tuff over a wide velocity range, and the results are presented graphically. A less precise, but simpler, scaling law is distilled from these data. Author

N65-35681# Utah Research and Development Co., Inc., Salt Lake City.
THEORETICAL AND EXPERIMENTAL STUDY OF LOW VELOCITY PENETRATION PHENOMENA, PHASES III, IV AND V Semiannual Report
May 1965 28 p refs
(Contract DA-19-129-AMC-150(X); ARPA Order 267)
(AD-617892)

A study of the strength of materials under large deformation has been conducted. The sample to be tested was in the form of a thin disk and was crushed between a fixed and a moving anvil. Velocities ranging from 10^{-3} to 10^4 cm/sec were obtained by driving the anvil either by a testing machine or by a compressed-air gun. A simplified analysis of the problem is given, and the assumptions used are discussed and compared with the experimental data. The relationship between internal energy of the material and deformation is found to be $U = \tau \ln (z_o/z)$ where U is energy per unit mass, z_o and z are initial and final thickness of the disk and τ is a constant, the strength of the material. Variations in τ are discussed in terms of strain-rate effects and strain-hardening effects. The materials tested were copper, 99.99 per cent pure aluminum, 6061-T4 and -T6 aluminum, nylon, Lexan, Teflon, polyethylene and polypropylene. Author

N65-35685# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
EFFECT OF A PLATE WITH DAMPING ON THE ACOUSTIC FIELD OF A POINT SURFACE Technical Report No. 37
M. B. Friedman and M. K. Myers Apr. 1965 22 p ref
(Contract Nonr-266(86))
(CU-3-65-ONR-266(86))-CE; AD-617737)

A formal solution is obtained for the effect of a thin infinite plate with damping on the sound field due to a point source located a small distance from the plate in a uniform acoustic medium occupying the half-space on one side of the plate, with a vacuum on the other side. Damping is introduced by the use of a complex flexural rigidity in the equation of motion of the plate. Approximate expressions are derived for the sound conduction caused by the plate for small values of the damping coefficient. The results are compared with the corresponding known results for an elastic plate. It is shown that the conduction effect is reduced by the presence of damping in the plate. Author

N65-35706# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
COMPLEX POISSON'S RATIO AND DILATION CONSTANTS FROM FORCED VIBRATION OF A SPHERE
T. M. Lee and J. L. Smith Feb. 1965 19 p refs
(CRREL-RR-165; AD-614461)

Following previous investigations on methods of determining dynamic mechanical properties of viscoelastic materials employing forced vibration, this report proposes a similar technique for determining the complex Poisson's ratio and the complex dilatation constants. Through the study of forced vibration of a free viscoelastic sphere with an internal harmonic oscillating source, it is found that these properties of the test material are related to the ratio of the vibration amplitude of two measurable points. Thus, when using the criterion of this ratio approaching its maximum, the maximum amplitude ratio, these properties can be expressed in simple relationship with laboratory-measurable quantities, namely the maximum amplitude ratios and their corresponding vibration frequencies. Investigations have been carried out for three sphere sets. Author

N65-35726# Army Missile Command, Huntsville, Ala.
PHOTOELASTICITY: ITS APPLICATIONS IN THE MECHANICAL INDUSTRIES
Henri Laboiteux and Robert Boussard Mar. 1965 27 p Transl. into ENGLISH from La Pratique des Ind. Mechaniques (France), v. 29, no. 1, Jan. 1946 p 3-7 and v. 29, no. 2, Feb. 1946 p 31-36
(RSIC-387; AD-617193)

Photoelasticity was used experimentally to solve the equations of the elasticity theory with accuracy through the use of optical methods. Two-dimensional stress problems were studied by modifications of a polarized light beam upon its passage through a plastic model and the establishment of isostatic lines. The complete network of isostatics was drawn and the isochromatic lines, as well as the real values of the two principle stresses were determined. Practical applications of photoelasticity to the case of a wrench, and to welding problems of sheet metal, are shown. G.G.

N65-35747# Brown Univ., Providence, R. I. Div. of Engineering.
ON THE MEANING OF CONCENTRATED LOAD SOLUTIONS IN THE PLASTIC THEORY OF STRUCTURES
C. A. Anderson and R. T. Shield Mar. 1965 87 p refs
(Contract Nonr-562(20))
(Nonr-562(20)/42; AD-615563)

The main purpose is to investigate the significance of the structural theory solutions when the loading is of a highly localized nature. Limit analysis is applied to illustrative problems involving structural elements of typical dimensions in order to compare the actual collapse loads with those provided by the structural theory. For a rectangular beam under various support conditions loaded by a strip of pressure or by a flat punch, it is found that as the width of the loaded region decreases the transition from the type of failure predicted by the beam theory to failure due to local plastic flow is very abrupt, and the beam theory is accurate up to the value of the load required to produce local plastic flow. A similar result is found for a circular cylindrical shell loaded symmetrically by a band of pressure, and it appears that for strip loading structural theory is valid for strip widths which are small in comparison to the beam or shell thickness. Author

N65-35750# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
COMPUTER-ANALYSIS METHODS FOR STRESS WAVES AND SPHERICAL CAVITIES Final Technical Report

Norman Davids and Pravin Mehta 30 Nov. 1964 95 p refs
(Contract DA-36-034-ORD-3576(RD))
(AD-612082)

Computer-oriented analyses are made of a group of dynamical problems, and specific full computer programs in Fortran II are included. The fundamentals of elastic waves in long bars are considered in terms of mathematical and computer analyses; and the wave index method and stability are discussed. Analyses and results are given for plastic waves in long bars, spherical elastic and elasto-plastic waves, and spherical plastic rigid or bulk waves. Expansion of a spherical cavity–quasi-static theory is presented. Basic printouts illustrate profiles for stress propagation, the basic geometry for plastic wave propagation is given, and the mechanics of a hemispherical element under stress are shown. M.W.R.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-34855# California Univ., Berkeley. Inst. of Engineering Research.
HEAT-TRANSFER AND SHEAR BETWEEN COAXIAL CYLINDERS FOR LARGE KNUDSEN NUMBERS
D. Roger Willis Jul. 1965 17 p refs
(Contract Nonr-222(45))
(AS-65-7; AD-469851)

The heat transfer between coaxial cylinders for large Knudsen number is obtained using the method of Knudsen iteration. The BGK model equation, together with an extension which allows the Prandtl number to be set arbitrarily, is used. Results are compared with those obtained by moment methods. It is found that the criterion proposed by Hurlbut for validity of the free molecular results is reasonable. Results are also presented for the rotating cylinder problem in a high Knudsen number flow. Author

N65-34878# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL STUDY OF HEAT AND MASS TRANSFER DURING TRANSPIRATION COOLING OF DIFFERENTLY SHAPED BODIES
G. T. Sergeyev and L. A. Sergeyeva 13 Jul. 1965 15 p refs Transl. into ENGLISH from Inzh. Fiz. Zh. (USSR), v. 6, no. 12, 1963 p 3–10
(FTD-TT-65-785/1+2+4; AD-618093)

Results are given from experimental studies of the process of heat and mass transfer in the case of the evaporative cooling with water of a sphere, disc or cone when variously oriented in a turbulent air flow. Author

N65-34889# Itek Corp., Palo Alto, Calif. Vidya Div.
MASS, MOMENTUM, AND HEAT TRANSFER WITHIN A TURBULENT BOUNDARY LAYER WITH FOREIGN GAS MASS TRANSFER AT THE SURFACE. PART 1: CONSTANT FLUID PROPERTIES Final Report
Robert M. Kendall, Morris W. Rubesin, Thomas J. Dahm, and Michael R. Mendenhall 1 Feb. 1964 158 p refs
(Contract Nonr-3997(00); ARPA Order 322; Proj. Defender)
(Rept.-111; AD-619209)

A critical reexamination is made of existing experimental data on the velocity, temperature, and concentration profiles in a low-speed, constant property turbulent boundary layer with surface mass injection. It is found that a model of the bundary layer can be constructed that fits the local profile data as well as the local drag, mass, and heat-transfer coefficients at the surface. The essential features of the model include a "law of the wall" that provides a continuous and smooth profile from the surface to the fully turbulent region and a "wake region" that joins the inner region smoothly and is characterized by an eddy diffusivity that is constant with respect to distance from the wall. Four empirical parameters appear in the analysis: the Prandtl mixing length constant, K; the Clauser eddy diffusivity Reynolds number; an inner region mixing length constant analogous to Rotta's intercept constant; and a value of turbulent Schmidt or Prandtl number. Constant values of these parameters are found to be suitable in predicting data over a wide range of surface blowing or suction and Reynolds number. Author

N65-34920# European Atomic Energy Community, Brussels (Belgium).
MEASUREMENT OF THE CRITICAL HEAT-FLUX-DENSITY OF SUBCOOLED WATER IN TUBES AT FORCED FLOW [MESSUNG DER KRITISCHEN WARMESTROMDICHTE VON WASSER IM UNTERKUHLTEN ZUSTAND IN ROHREN BEI ERZWUNGENER STROMUNG]
E. Burck and W. Hufschmidt Jun. 1965 39 p refs In GERMAN; ENGLISH summary
(EUR-2432.d) CFSTI: HC $2.00/MF $0.50

The critical heat flux density (burnout) of subcooled water in a stainless steel tube of 10 mm i.d. and a length of 350 mm has been investigated. The critical heat flux density increased with increasing pressure, subcooling and mass flow density. A variation of the wall thickness of the tube in the tested range had no influence on burnout. Author

N65-34975# Technische Hogeschool, Delft (Netherlands). Lab. voor Verbrandingsmotoren en Gasturbines.
HEAT TRANSFER IN BOILING—A LITERATURE SURVEY
V. A. Ogale 14 Aug. 1964 12 p refs
(Rept.-10.m.002) CFSTI: HC $1.00/MF $0.50

A literature survey on the process of evaporation associated with the transfer of heat from a solid surface to a fluid is presented. Such areas as regimes in boiling, heat transfer correlation, nucleation, maximum heat flux, and forced convection boiling correlation are discussed with emphasis on nucleation. The phenomenon of boiling heat transfer is shown to be dependent on the temperature difference and the nature of the surface. C.T.C.

N65-35055# Technische Hogeschool, Delft (Netherlands). Lab. voor Verbrandingsmotoren en Gasturbines.
LIQUID METAL HEAT TRANSFER—A LITERATURE SURVEY
V. A. Ogale 28 Jul. 1964 23 p refs
(Rept.-10.M.001) CFSTI: HC $1.00/MF $0.50

Heat transfer data for liquid metals were investigated. A comparison of the thermal conductivities of liquid metals and several ordinary fluids is presented. Types of liquid corrosion and resistance against corrosion by liquid sodium potassium are discussed. Other topics considered are: heat transfe

predictions inside circular tubes; theory of turbulent liquid metal heat transfer; and effect of scale and liquid solid contact resistance. Expressions for heat transfer in liquid metals for forced, natural, and free convection are described. Handling, storage, and safety precautions for liquid metals are also included. M.R.W.

N65-35056# Technische Hogeschool, Delft (Netherlands). Lab. voor Verbrandingsmotoren en Gasturbines.
TEMPERATURE MEASUREMENTS AT HIGH TEMPERATURES AND HIGH SPEEDS—A LITERATURE SURVEY
V. A. Ogale Aug. 1965 50 p refs
(Rept.-10.m.003) CFSTI: HC $3.00/MF $0.50

A review is made of the possible methods of temperature measurement for high speeds and high temperatures. At the end of this survey a choice has been made of the temperature measuring method which is thought to be most suitable for the cooled gas turbine project. Author

N65-35057*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF LEADING-EDGE BLUNTNESS ON PRESSURE AND HEAT-TRANSFER MEASUREMENTS OVER A FLAT PLATE AT A MACH NUMBER OF 20
William D. Harvey Washington, NASA, Oct. 1965 42 p refs
(NASA-TN-D-2846) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An experimental investigation has been conducted to study the effects of viscous interaction and leading-edge bluntness on flat-plate pressures and heat-transfer coefficients at a Mach number of approximately 20. The investigation was conducted at a nominal stagnation temperature and pressure of about 4000° R and 10 000 pounds per square inch for a free-stream Reynolds number per foot of about 0.46×10^6. The pressure data for the sharp leading-edge flat plate indicated a region of transition between the free molecule flow and continuum flow regions near the leading edge. Experimental results from the blunt leading-edge configurations were in agreement with those from the linear addition of inviscid and viscous effects. The blast-wave theory gave good approximations of the shock shapes of the blunt leading-edge configuration. The boundary-layer growth measured from schlieren photographs of the sharp plate gave fair agreement when compared with the hypersonic boundary-layer theory. Author

N65-35086# United Technology Center, Sunnyvale, Calif. Research and Advanced Technology Dept.
VAPOR-PHASE COMBUSTION OF BERYLLIUM AND ALUMINUM Final Technical Summary Report, 1 Dec. 1962–30 Nov. 1964
R. W. Hermsen and R. W. Woolfolk 31 Dec. 1964 59 p refs
(Contract AF 49(638)-1202)
(UTC-2040-FR; AFOSR-65-1056; AD-617938)

An experimental investigation of the vapor-phase combustion of aluminum and beryllium has been undertaken using electrically vaporized wires as the source of high-temperature, high-pressure metal vapor. One gram of aluminum in the form of a wire 0.062 in. in diameter by 8 in. long has been vaporized in less than 20 μsec using 15 kj of electrical energy stored in a 150μ flow-inductance capacitor bank. Aluminum wires have been vaporized into atmospheres of dry N_2 and Ar and Various O_2–N_2 mixtures both with and without water vapor, all at an initial pressure of 1 atm. Both high-speed streak and framing schlieren photographs have been obtained of the expanding metal vapor, which appears to be opaque to the schlieren backlight and highly luminous in the presence of oxygen. The trajectory of the interface between the metal vapor and surrounding atmosphere appears to be influenced by the initial concentration of oxygen. Author

N65-35126* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
TRANSIENT MEASUREMENT OF THERMAL DIFFUSIVITY OF REFRACTORY MATERIALS AT HIGH TEMPERATURE
Manfred Altman and H. Chang *In its* [Res. in Mater., Plasma and Electrochem. Eng.] 1 Jul. 1965 6 p refs (See N65-35125 23-34) CFSTI: HC $3.00/MF $0.75

Cylindrical samples of LiF were generated by melting LiF powder (Fisher Certified Reagent powder) in a carbon crucible. The samples are 6" long and 1" diameter. The carbon crucible served both as the melt container and the susceptor for the high frequency induction furnace. These cylinders are at present being drilled to accommodate a 1/8" hole in the center, 3" deep from the bottom end of the sample. A pair of thermocouples made out of .016" chromel-alumel wires will be inserted into this hole through high purity alumina insulators with the bead touching the end of this hole. An identical thermocouple from the same lot of wires will be attached to the surface of the sample 3" from the bottom of the sample. The bead of this surface thermocouple will be inserted into a small indenture on the surface of the sample and then tied to the sample by a piece of platinum wire. An alternate drilling procedure is being tried to obtain two 1/16" holes 2 3/4" deep from the bottom end of the sample. One of the holes is at the center of the sample and the other is close to the wall and centered 0.45" from the center hole. Author

N65-35204*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HEAT TRANSFER TO A SEEDED FLOWING GAS FROM AN ARC ENCLOSED BY A QUARTZ TUBE
Chester D. Lanzo and Robert G. Ragsdale [1964] 18 p refs
(NASA-TM-X-52005) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Experimental results are presented for combined radiation and forced-convection heat transfer to air containing submicron carbon particles flowing in the annulus of a transparent heat exchanger. The heat exchanger consisted of two concentric quartz tubes; the heat source was an electric arc contained in the inner tube and stabilized by the vortex-type flow of nitrogen gas. Air flowing through the annular region was made absorptive to thermal radiation by the addition of submicron carbon particles, and the seed injection system used for dispersing the particles in the airstream is described. For arc power levels from 126 to 167 kilowatts, and carbon particle seeding from 1 to 2.5 weight percent, results indicate that a quartz tube contained electric arc is effective for radiation heat transfer studies; and that the addition of a small amount of solid particles to a flowing transparent gas significantly increases the total heat transfer in a system where both forced convection and radiation heat sources are present. M.G.J.

N65-35221*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A THERMAL VACUUM TECHNIQUE FOR MEASURING THE SOLAR ABSORPTANCE OF SATELLITE COATINGS AS A FUNCTION OF ANGLE OF INCIDENCE
Marla G. Hoke [1963] 31 p refs Submitted for Publication
(NASA-TM-X-51837) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An experimental technique for measuring the solar absorptance of a satellite coating as a function of angle of incidence has been developed. A thermal vacuum method is used to measure the equilibrium temperature of a coated sample as the sample is turned with respect to the incident beam by means of a rotational apparatus installed in the vacuum chamber. Preliminary measurements of the directional solar absorptance of the following materials have been made: evaporated aluminum, evaporated gold, aluminum leafing paint, zinc

sulfide paint, and Parson's black paint. The hemispherical solar absorptance is calculated for evaporated aluminum. Author

N65-35239*# AVCO-Everett Research Lab., Everett, Mass.
NONEQUILIBRIUM SHOCK FRONT ROTATIONAL, VIBRATIONAL AND ELECTRONIC TEMPERATURE MEASUREMENTS
Richard A. Allen Jun. 1964 5 p refs *Its* Res. Note No. 459 (Contract NASw-748)
(NASA-CR-56616) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A spectroscopic method for taking nonequilibrium shock front rotational, vibrational, and electronic temperature measurements in the relaxation zone is presented. Qualitatively, the method used consisted in the examination of the variation in the molecular band structure of the radiation, working backward in laboratory time from the equilibrium region into the nonequilibrium region, after assuming an equilibrium temperature based on the shock conditions. The equipment used in the measurements included an electric arc-driven six-inch shock tube, and a Jarrel–Ash triple channel monochromator. Shock tube spectra showed the $N_2^+(1-)$ radiation to be the prominent radiator from the nonequilibrium and equilibrium regions of incident nitrogen shock between 3500 and 4500 Å, and at temperatures in the vicinity of 7000° K. G.A.L.

N65-35243*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GRADUAL TRANSITION OF NUCLEATE BOILING FROM DISCRETE-BUBBLE REGIME TO MULTIBUBBLE REGIME
Yih-Yun Hsu Washington, NASA, 1964 31 p refs Presented at the Heat Transfer Conf. and Prod. Show Sponsored by Am. Inst. of Chem. Eng. and by ASME, Cleveland, 9–12 Aug. 1964
(NASA-TM-X-52017) CFSTI: HC $2.00/MF $0.50 CSCL 20M

A photographic study was made of over 5000 bubbles in the nucleate boiling of methanol and water on a narrow heating strip at various heat fluxes and degrees of subcooling. The result showed that transition from the discrete-bubble regime to the multibubble regime was gradual. The fraction of heating area covered by multibubbles increases with the increasing heat flux and is predictable. The area fraction is a Poisson function of the product of the mean area of influence of single bubbles and the instantaneous population density. Author

N65-35248*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A SIMPLE EQUATION FOR CORRELATING TURBULENT HEAT TRANSFER TO A GAS
R. J. Simoneau and R. C. Hendricks Washington, NASA, 1964 23 p refs Presented at the Heat Transfer Conf. and Products Show Sponsored by Am. Inst. of Chem. Engr. and ASME, Cleveland, 9–12 Aug. 1964
(NASA-TM-X-52011) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Many investigators have employed the conventional Dittus–Boelter (Nusselt type) equation modified by a wall to bulk temperature ratio to correlate turbulent heat transfer data for gases flowing through heated tubes. It has been found that the reported convective data for hydrogen, helium, air, and carbon dioxide can be correlated to the same accuracy as the Nusselt type correlations by use of the equation $h = K(pV)_b^{0.8} d^{-0.2} \sqrt{T_b/t_w}$ where K is a constant for any given gas. This equation suggests that for the four gases investigated, a convective correlation for a given gas need not include the temperature dependence of the thermal and transport properties. Based on the plots of these reported data, the values of K are: for hydrogen, 0.0480, for helium, 0.0200, for air, 00420, and for carbon dioxide, 0.00385. These data covered the conditions of film temperature from 500° to 3400° R with wall to bulk temperature ratios from 1.1 to 9.9. No appreciable dissociation was reported in the data. The minimum bulk temperature was 150° above the critical temperature. The bulk Reynolds number ranged from 5000 to 1,500,000 with heat fluxes up to 3 Btu per second per square inch. Tube diameters varied from 1/8 to 1/2 inch. Author

N65-35251*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ANALYTIC SOLUTIONS TO THE IGNITION KINETICS OF THE HYDROGEN–OXYGEN REACTION
Richard S. Brokaw Washington, NASA, 1964 27 p refs Presented at the 10th Intern. Symp. on Combust., Sponsored by Combust. Inst. and Cambridge Phys. Chem. Dept., London, 17–21 Aug. 1964
(NASA-TM-X-52003) CFSTI: HC $2.00/MF $0.50 CSCL 21I

Solutions were obtained assuming isothermal conditions and negligible depletion of reactants during the induction period for a given group of reactions. Three types of solutions were deduced: a low temperature, high pressure region of long ignition delays; a high temperature, low pressure region of short delays; and the boudnary between the two regions. Experimental ignition delays in long and short delay regions were explained, and ignition delays computed by numerical integration of the rate equations were reproduced to within a few percent. Ignition delays for the Von Neumann spike condition in Chapman–Jouguet detonations of the lean limit of detonability in air were calculated. R.W.H.

N65-35316*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF MERCURY CONDENSING PRESSURE DROPS
M. Gutstein, R. T. Wainwright, and A. Koestel (Thompson Ramo Wooldridge, Inc.) Washington, NASA, 1964 41 p refs Presented at the Winter Ann. Meeting, ASME, New York, Nov. 29–Dec. 4, 1964
(NASA-TM-X-52034) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Experiments are described wherein the local static pressures were measured along tubes in which mercury vapor was flowing and condensing. Data were obtained at flow rates of 1.05 to 3 lb/min, at inlet pressures of 8 to 30 psia, and at condensing lengths of 4 to 8 ft. Both constant diameter and tapered tubes were employed in the study. A comparison of the two-phase frictional pressure drop with the Lockhart-Martinelli correlation showed significant deviations, particularly at low qualities. A relation between the frictional pressure drop and the Weber number, derived from fog-flow considerations, correlated the trend of the data over the full quality range. Experimental data obtained from the literature were utilized to further support this fog-flow correlation. Author

N65-35327# European Atomic Energy Community, Brussels (Belgium).
EVALUATION OF CALCULATIONS ON THE PROBLEM OF HEAT TRANSFER BY RADIATION IN SOLIDS [AUSWERTUNG VON RECHNUNGEN ZUM PROBLEM DER WARMELEITUNG DURCH STRAHLUNG IN FESTKORPERN]
J. Richter and H. E. Schmidt 1965 13 p refs In GERMAN (EUR-2409.d) CFSTI: HC $1.00/MF $0.50

Calculations on the temperature profiles of solid bodies having different optical properties in the presence of radiation and phonon flow, are reported together with a series of diffusion measurements on UO_2 single crystals at temperatures from

1000° C to 1850° C. Temperature profiles were linear at low temperatures and low optical densities. The effective heat transfer of UO_2 samples up to 0.5 mm thickness was not effected by phonon radiation. Transl. by G.G.

N65-35335# Aerojet-General Nucleonics, San Ramon, Calif.
THE DETERMINATION OF THE LATENT HEAT OF VAPORIZATION AND VAPOR PRESSURE OF POTASSIUM FROM 1000 TO 1900°F Topical Report
P. Y. Achener Apr. 1965 36 p refs
(Contract AT(04-3)-368)
(AGN-8141)

The latent heat of vaporization and vapor pressure of potassium were determined experimentally in the temperatures ranges of 1008 to 1907° F and 985 to 1908° F, respectively. The apparatus designed for this measurement was of the flow calorimeter type, comprising a boiler with an internal heater and a guard heater, a condenser, and a volumeter in which the rate of vaporization was measured. The boiling temperature was established by means of an argon overpressure. For the latent heat of vaporization, a technique of double measurements was developed which permitted the elimination of heat losses between boiler and guard heater. Analysis of the results of the vapor pressure and latent heat determinations, and comparison with results of other investigators have shown some of the limitations of the calculational method based on the Clapeyron equation to obtain latent heat from the vapor pressure data. Author

N65-35351*# California Univ., Berkeley.
INFRARED RADIATION MEASUREMENTS OF COMBUSTION GASES Third Quarterly Progress Report, 1 Jan.–31 Mar. 1965
M. M. Abu-Romia, L. S. Wang, W. H. Giedt, and C. L. Tien
15 Apr. 1965 21 p
(Contract NAS8-11468)
(NASA-CR-67315) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Spectral absorption measurements of CO at 1200° K were carried out at pressures of 0.5, 1, 2 and 3 atmospheres and optical path lengths of 5, 10 and 20 centimeters. The sapphire windows used at the ends of the absorption test path are transparent in the 0.2 to 7 μ wave length region. The data obtained therefore cover the fundamental (4.67 μ) and the first overtone absorption bands. Spectral and integrated absorptivites for the CO fundamental band were evaluated from these measurements and are presented herein. Results for the first overtone absorption band are presented only for the 20 centimeter path length at pressures of 1, 2 and 3 atmospheres. At shorter path lengths the amount of absorption was insufficient to permit accurate computation of spectral absorptivity. A literature search of previous experimental investigations pertaining to infrared absorption characteristics of CO and CO_2 has been completed. A summary of existing data is presented in tabular form. Author

N65-35422# Rocketdyne, Canoga Park, Calif.
RADIATIVE PROPERTIES OF GASES. VOL. I: GENERAL DISCUSSIONS
R. V. Miller and S. A. Golden 12 Aug. 1965 refs
(Contract Nonr-4623(00))
(R-6272; AD-619266)

This report describes theoretical studies of the basic radiative properties of high temperature gases. The primary emphasis of this work has been devoted to methods of calculating spectral absorption coefficients of electronic transitions in diatomic molecules. The smeared line model has been used to calculate absorption coefficients in fifty such transitions. Ancillary work has included studies of methods of calculating numerical potential functions of the Rydberg–Klein–Rees type, solutions to the Schroedinger equation with such potential functions, and computational procedures for evaluating Frank–Condon and r-centroid factors. Author

N65-35435# Naval Postgraduate School, Monterey, Calif.
AN EXPERIMENTAL DETERMINATION OF HEAT TRANSFER AND FLOW FRICTION CHARACTERISTICS OF PERFORATED MATERIAL FOR COMPACT HEAT EXCHANGER SURFACES
John M. Bannon (M.S. Thesis) 1964 103 p refs
(AD-621483)

The transient testing technique for the determination of heat transfer characteristics of a porous medium has been known since 1929. It requires a good deal of care and one of the important restrictions is a step change in temperature must be applied to the medium at the beginning of a test run. This thesis involves the design, test and evaluation of an experimental set-up that utilizes an integral heater to accomplish the step change in temperature. In addition, there is presented heat transfer and flow friction characteristics for a 20° skew matrix constructed from perforated nickel material. This data is compared to a 20° skew matrix made from stainless steel material that has been previously reported by C. P. Howard. Also, data is presented for two parallel plate matrices, one constructed from brass sheet, the other from perforated nickel material. A comparison of their relative performances is made. Author

N65-35436# Naval Postgraduate School, Monterey, Calif.
SOME SELF-HEATING CHARACTERISTICS OF VERY SMALL RESISTANCE STRAIN GAGES
Anthony G. Hartman (M.S. Thesis) 1964 109 p refs
(AD-621482)

The self-heating of small foil resistance strain gages is studied both analytically and experimentally. The thermal resistance of the strain gage-specimen combination is obtained and utilized in relating the steady state temperature rise of the gage grid to the magnitude of the electrical current flowing through the gage. It is shown that the primary mechanism for dissipation of the gage self-heat is conduction through the gage backing, bonding adhesive, and specimen, then radiation and convection from the specimen surfaces to the environment. The heat dissipation paths provided by the lead wires and the exposed gage grid and tab surfaces are found to account for a negligible fraction of the heat transferred. For the smallest gages the backing and adhesive contribute nearly all of the thermal resistance of the primary path. In the latter cases it is shown that gage heating is substantially independent of the thermal conductivity or size of the specimen and that the gage power dissipation per unit grid area is the dominant parameter in predicting the steady-state temperature rise of the grid. Author

N65-35460# United Kingdom Atomic Energy Authority, Risley (England). The Reactor Group.
HEAT TRANSFER BY MEANS OF ORGANIC LIQUIDS
G. C. Pinchera 1965 26 p refs Transl. into ENGLISH from Energia Nucl. (Milan), v. 10, no. 6, 1963 p 319–335
Presented at the 7th Congr. Nucl. di Roma
(TRG-449(W)) HMSO: 3s 6d

Stability, composition and physical properties of polyphenyl coolants circulating in a reactor cooled with an organic liquid are reviewed. Stress is laid on the importance of a more

accurate knowledge of composition and the physical properties of such substances for a better interpretation of their heat transfer data. Heat transfer characteristics of organic liquids are discussed; and recent experimental results and the reliability of the proposed correlations are examined, with particular reference to forced convection, nucleate boiling, critical heat flux, and the effects of fouling on heat transfer. Author

N65-35464# Witwatersrand Univ., Johannesburg (South Africa). Dept. of Mechanical Engineering.
THE DETERMINATION OF LAMINAR BURNING VELOCITY WITH PARTICULAR REFERENCE TO THE CONSTANT VOLUME METHOD. PART 3: EXPERIMENTAL PROCEDURE AND RESULTS
C. J. Rallis, A. M. Garforth, and J. A. Steinz Mar. 1965 155 p refs
(Rept.-26) CFSTI: HC $5.00/MF $1.00

Continued research conducted under a program focusing on the determination of laminar burning velocities using the spherical constant volume vessel method, is reported. Described are experimental and data processing procedures used in assessing the overall accuracy of burning velocity determinations of certain acetylene-air mixtures. Results are used to show the dependence of laminar burning velocity of acetylene-air mixture composition, pressure, and temperature. Included is a synoptic appraisal of the overall combustion program. S.C.W.

N65-35521*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STUDY OF HEAT SHIELDING REQUIREMENTS FOR MANNED MARS LANDING AND RETURN MISSIONS Summary Report
Washington, NASA, Oct. 1965 14 p
(Contract NAS2-1798)
(NASA-CR-308) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The parametric determination of heat shielding requirements for manned entry at both Earth and Mars is studied, considering as variables entry velocity, vehicle volume, and vehicle weight. The vehicle configurations, entry situations, and parameter ranges considered are summarized in a table. In addition, major technical problems and associated uncertainties in heat shield design are delineated. Parametric data were analyzed by computer, and the significant results are presented in the areas of flight mechanics, atmospheric characteristics, heat transfer, and heat shielding requirements. Graphs are presented showing the influence of radiative cooling on radiative energy transfer; the influence of vorticity on convective heat transfer; the comparison of uncorrected heat input with actual heat input; the comparison of heat shielding requirements for various earth entry vehicles; entry speed; the influence of ballistic coefficient on heat shielding requirements; and the influence of environmental uncertainties on heat shield requirements for an M-1 vehicle. The implications for future research effort are indicated. L.S.

N65-35560# Sandia Corp., Albuquerque, N. Mex.
ANALYTICAL METHODS USED IN PREDICTING THE RE-ENTRY ABLATION OF SPHERICAL AND CYLINDRICAL BODIES
L. O. Cropp Sep. 1965 95 p refs
(SC-RR-65-187) CFSTI: $3.00

Heating and ablation of spherical and cylindrical bodies are considered from their initial point of return from earth orbit to the time when all ablation ceases. Analytical processes used for aerospace nuclear safety studies are detailed, and the thermophysical properties required for an ablation analysis are outlined. An appendix also presents a general outline of topics which must be considered in making an ablation analysis. Trajectory analysis, aerodynamic and chemical heating, heat sinks, and heat balance for reentering bodies are discussed. Determination of molten particle sizes is considered, and thermal modeling for the fusion process is detailed. It is emphasized that the performance of an ablation analysis is not a precise science, and any result is based on many assumptions. Many complex parameters must be included in any ablation analysis. M.W.R.

N65-35617# Cincinnati Univ., Ohio.
A SIMPLIFIED ANALYSIS OF VECTORIAL INJECTION IN HYPERSONIC FLOW Interim Technical Report
Philip S. Kirk Wright-Patterson AFB, Ohio, ARL, Mar. 1965 39 p refs
(Contract AF 33(616)-8453)
(ARL-65-50; AD-615326)

Equations relating to laminar binary boundary layer flow are solved approximately, in accordance with the boundary conditions for vectorial injection. Expressions for the skin friction and heat transfer coefficients are derived, together with their normalized representations. Author

N65-35629# Air Force Systems Command, Kirtland AFB, Calif. Air Force Weapons Lab.
SPLINE INTERPOLATION AND DIFFERENTIATION SUBROUTINE FOR THE EQUATION OF STATE OF AIR Technical Report, Oct. 1964–Dec. 1964
Martin L. Havens May 1965 53 p refs
May 1965 53 p refs
(AFWL-TR-65-38; AD-616000)

A computer subroutine is described which applies the spline method of numerical interpolation and differentiation to a tabular set of data relating the equation-of-state and energy equation variables for air. Fortran listings of two versions of the subroutine and the derivation of the spline interpolation equation are included. Author

N65-35664# Army Missile Command, Huntsville, Ala.
DETERMINING THE THERMAL CONTACT RESISTANCE BETWEEN METAL-CERAMIC SURFACES
V. S. Miller Apr. 1965 11 p refs Transl. from Akad. Nauk Ukr. SSR (Kiev), v. 20, 1960 p 54–59
(RSIC-401; AD-617271)

The process of heat transfer through contact between metal-ceramic surfaces was studied. Investigations were conducted on silicon carbide alloys each having a distinct composition and heat conductivity. The specimens were categorized into groups of various purity surface. The strength of pressure between the contacting surfaces changed from 5 to 400 kg/cm^2, and was achieved by using special hydraulic presses. The heat flow in some specimens reached 220 to 250 thousand cal/m^2 hour at the average temperature zone of contact at 290° C to 300° C. The magnitude of the thermal resistance of the metal-ceramic surfaces was determined formula, and the data are tabulated. Graphs showing the dependency of the thermal resistance of contact on the pressure composition of the metal ceramic alloy, and on the quality of the surface finish are presented. L.S.

N65-35754# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PECULIARITIES OF THE MEASUREMENTS OF TEMPERATURE UNDER CONDITIONS OF ALTERNATING HEAT EMISSIONS

A. N. Gordov 5 Apr. 1965 13 p refs Transl. into ENGLISH from Izmeritel. Tekhn. (USSR), no. 5, 1957 p 29–32
(FTD-TT-64-1076/1; AD-615431)

The peculiarities of the changes in the temperature of a body as a result of its heat exchange with the surrounding medium are studied. These studies are applied to determination of the dependability of measurements of the temperature of fluids by immersion temperature pickups. Author

N65-35762# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
WAVES IN MATERIALS WITH MEMORY. IV: THERMODYNAMICS AND THE VELOCITY OF GENERAL ACCELERATION WAVES
Bernard D. Coleman and Morton E. Gurtin 8 Mar. 1965 55 p refs
(Contract Nonr-562(10))
(TR-99; AD-616747)

Wave propagation in general materials with memory is discussed, and it is shown that the theory of acceleration waves in such materials can be based on the notion of an instantaneous acoustic tensor. The main result proves that the second law of thermodynamics implies the symmetry of this acoustic tensor. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-34725# Joint Publications Research Service, Washington, D. C.
NEWS OF THE ACADEMY OF SCIENCES USSR, DEPARTMENT OF SCIENCES, TECHNICAL CYBERNETICS, NO. 3, 1965
14 Sep. 1965 294 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, OTN.: Tekh. Kibernetika (Moscow), no. 3, May–Jun. 1965 p 1–208
(JPRS-31990; TT-65-32484) CFSTI: $6.00

Selected articles on statistical methods, optimization, control theory, and computer theory are presented. For individual titles see N65-34726–N65-34752.

N65-34778# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 215
13 Sep. 1965 50 p refs Transl. into ENGLISH from Chinese publications
(JPRS-31961; TT-65-32455) CFSTI: $2.00

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1. DETERMINATION OF SECOND ORDER CORRECTION TERM IN MEASUREMENT OF GRAVITY AT SEA H.-c. Li p 1–10 refs (See N65-34779 23-13)

2. X-RAY INVESTIGATION OF THE STRUCTURAL CHANGES OF AN Al-Zn(7.49%)-Mg(1.47%) ALLOY DURING LOW TEMPERATURE AGE-HARDENING (I) P.-c. Chang, C.-t. Ch'ueh, and H.-k. Chu p 11–17 refs (See N65-34780 23-17)

3. CHINESE ACHIEVEMENTS IN PEDIATRICS Fut'-ang Chu p 18–20

4. A NEW PHOSPHOROUS FERTILIZER PRODUCED BY NANKING RESEARCH ACADEMY OF CHEMICAL ENGINEERING p 21

5. CHINA'S YOUNG WEATHER WORKERS PRESENT NEW THEORY ON RAIN p 22–24

6. NEW CHINA'S HIGHER-LEVEL EDUCATION Chia-yang Shih p 25–28

7. SEVEN THOUSAND GRADUATES FROM KUANG-TUNG'S COLLEGES p 29

8. THE BOUNDARY LINE BETWEEN MAN AND APE Chan-yuan Wang p 30–45 refs

9. THE PURPLE MOUNTAIN OBSERVATORY TODAY p 46–47 (See N65-34781 23-11)

10. HANG CHOU BOILER PLANT USES THE "EXPLOSION MOLDING" TECHNIQUE p 48

N65-34786# Joint Publications Research Service, Washington, D. C.
SPECTROSCOPY AND METROTECHNOLOGY IN CZECHOSLOVAKIA
16 Sep. 1965 30 p refs Transl. into ENGLISH of 2 articles from Feingeratetechnik (East Berlin), no. 7, Jul. 1965 p 289–296, 304–307
(JPRS-32033; TT-65-32527) CFSTI: $2.00

CONTENTS:

1. SPECTROSCOPY OF ACTIVATED LASER CRYSTALS (PART III) P. Gorlich, H. Karras, G. Kotitz, R. Lehman, and W. Ludke p 1–18 refs (See N65-34787 23-34)

2. DEVELOPMENT OF METROTECHNOLOGY IN CZECHOSLOVAKIA AND INTERNATIONAL COOPERATION IN METROTECHNOLOGY F. Dostal p 19–27 (See N65-34788 23-15)

N65-35025# Sandia Corp., Albuquerque, N. Mex.
A SMALL-SCALE INVESTIGATION OF EXCAVATION WITH PARALLEL ROWS OF EXPLOSIONS
L. J. Vortman Sep. 1965 63 p refs
(SC-RR-65-303) CFSTI: $3.00

Rows of 8-pound spherical charges of TNT buried 3 feet deep and spaced 4 feet apart were fired in parallel configurations. This report describes the variations in relative cratering effectiveness of explosives as a function of spacing between rows for both simultaneous and sequential detonation of the rows. The intent was to model at small scale the similar use of nuclear explosives for excavation of overburden from ore bodies to permit open-pit mining. Results indicate that wide craters can be excavated more effectively by parallel row charges fired sequentially than if the rows are fired simultaneously. The data imply that some combinations of closer spacings and deeper burial depths than those tested could increase the efficiency of multiple rows to approach and even exceed that of single rows. Author

N65-35125*# Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.
[RESEARCH IN MATERIALS, PLASMA AND ELECTROCHEMICAL ENGINEERING] Status Report
1 Jul. 1965 64 p refs
(Grant NsG-316)
(NASA-CR-67221; INDEC-SR-6) CFSTI: HC $3.00/MF $0.75
CSCL 20

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1. TRANSIENT MEASUREMENT OF THERMAL DIFFUSIVITY OF REFRACTORY MATERIALS AT HIGH TEMPERATURE M. Altman and H. Chang 6 p refs (See N65-35126 23-33)

2. PARTIAL MOLAR PROPERTIES OF MAGNESIUM BASE BINARY THERMAL ENERGY STORAGE SYSTEMS G. Belton and Y. Rao 12 p refs (See N65-35127 23-06)

3. VOLUME CHANGE ON FUSION FOR CHLORIDES AND FLUORIDES R. A. Sharma 7 p refs (See N65-35128 23-06)

PLASMA ENGINEERING

4. INVESTIGATION OF Na-K SEEDED ARGON PLASMA H. Yeh, C. F. Gottschlich, and T. K. Chu 7 p (See N65-35129 23-25)

5. EMITTER SURFACE PHYSICS OF PLASMA DIODES L. W. Zelby, G. L. Schrenk, and M. Kaplit 6 p refs (See N65-35130 23-25)

6. THEORETICAL AND EXPERIMENTAL INVESTIGATION OF A ROTATING PLASMA IN A CROSSED ELECTRIC AND MAGNETIC FIELD M. Altman, M. A. Brull, and P. Hsueh 12 p refs (See N65-35131 23-25)

ELECTROCHEMICAL ENGINEERING

7. TRANSIENT CONCENTRATION POLARIZATION IN NATURAL CONVECTION ELECTROLYSIS L. Nanis and A. Adubifa 8 p refs (See N65-35132 23-25)

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